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Document Cover Sheet
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Document Type:

☒ **National List Petition or Petition Update**

A petition is a request to amend the USDA National Organic Program's National List of Allowed and Prohibited Substances (National List).

Any person may submit a petition to have a substance evaluated by the National Organic Standards Board (7 CFR 205.607(a)).

Guidelines for submitting a petition are available in the NOP Handbook as NOP 3011, National List Petition Guidelines.

Petitions are posted for the public on the NOP website for Petitioned Substances.

☐ **Technical Report**

A technical report is developed in response to a petition to amend the National List. Reports are also developed to assist in the review of substances that are already on the National List.

Technical reports are completed by third-party contractors and are available to the public on the NOP website for Petitioned Substances.

Contractor names and dates completed are available in the report.

Petition to Amend 7 CFR §205.601 to Add Polyoxin D Zinc Salt as a Synthetic Substance Allowed for Use In Organic Crop Production (May 31, 2016): February 2, 2018 Addendum

NON-CONFIDENTIAL

Submitted on Behalf of:
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EXECUTIVE SUMMARY

Proposed Amendment
Kaken Pharmaceutical Co., Ltd. (Kaken) proposes to *amend 7 CFR §205.601(i) to add polyoxin D zinc salt* as a synthetic substance allowed for use in organic crop production as plant disease control.

Petitioned Substance
The petitioned substance is *limited* to polyoxin D zinc salt which is a 1:1 complex of polyoxin D and zinc. The CAS number for polyoxin D zinc salt is 146659-78-1. The U.S. Environmental Protection Agency registration number of Polyoxin D Zinc Salt Technical is EPA Reg. No. 68173-1. The associated formulation proposed for use in organic agriculture is limited to the polyoxin D zinc salt 5SC formulation [Veggieturbo 5SC Suspension Concentrate Fungicide (EPA Reg. No. 67173-4) and Oso 5%SC Fungicide (EPA Reg. No. 67173-4-70051)].

Polyoxin D is *naturally occurring*. It is a fermentation product of a naturally occurring microorganism that is *not* genetically modified.

Polyoxin D is highly water soluble. To reduce its water solubility and thereby increase resident time on plant surfaces, polyoxin D is converted to polyoxin D zinc salt via a simple chemical reaction. This simple chemical reaction is the rationale for the National Organic Standards Board's April 2013 recommended classification of polyoxin D zinc salt as a synthetic substance. Kaken purchases the starting material containing zinc and does *not* control the origin of the zinc (mined vs recycled).

Based upon detailed chemical analyses submitted to and reviewed and accepted by the US EPA, Polyoxin D Zinc Salt Technical (EPA Reg. No. 68173-1) does *not* contain any toxicologically significant heavy metal impurities at or above the level of detection.

Petition Scope
Fourteen polyoxins have been identified and have been designated polyoxin A through polyoxin N. Polyoxin A through polyoxin N each have a *different* chemical structure. The properties of polyoxins vary with the chemical structures.

The petitioned substance does *not* include all polyoxins. Specifically, the petitioned substance does *not* include:

- Polyoxin A through C;
- Polyoxin E though N;
- Polyoxin A through C in combination with zinc; and/or
- Polyoxin E though N in combination with zinc.

Polyoxin Complex is *outside* the scope of this petition. Polyoxin Complex is a produced by Kaken and is marketed in Asia. Polyoxin Complex contains multiple polyoxins and has significantly different efficacy compared to polyoxin D zinc salt.

Not an Antibiotic
Worldwide, Polyoxin D Zinc Salt Technical is produced and registered *exclusively* by Kaken Pharmaceutical Co., Ltd. (Kaken). This does *not* make Polyoxin D zinc salt an antibiotic. Polyoxin D and polyoxin D zinc salt are *not* antibiotics. Worldwide, polyoxin D and polyoxin D zinc salt have *never* been marketed for use as pharmaceuticals for use in human medicine or in veterinary medicine. Based upon screening data, polyoxin D has *no commercially viable efficacy* against tested common human or veterinary pathogens (bacteria, fungi, and yeast).

Reduced Risk Pesticide

Polyoxin D zinc salt is a *reduced risk biopesticide* for the control of listed fungal pathogens on crops.

- Polyoxin D is *naturally occurring*. It is a fermentation product of a naturally occurring microorganism (non-GMO).
- Polyoxin D zinc salt has a *non-toxic mode of action*. It is a competitive enzyme inhibitor and stops the growth and pathogenicity of sensitive crop pathogenic fungi. Polyoxin D zinc salt *does not kill the target fungi*.

Polyoxin D zinc salt is regulated by the US Environmental Protection Agency's Biopesticide and Pollution Prevention Division, *i.e.*, the *same* US EPA Division that regulates the NOP *non-synthetic* active ingredients. The currently permitted NOP synthetic active ingredients:

- Are *not* considered by the US EPA to be reduced risk pesticides; and
- Are regulated as conventional pesticides by the US EPA Registration Division.

Polyoxin D zinc salt has been classified by NOP as a synthetic substance due to the chemical reaction used to convert polyoxin D to polyoxin D zinc salt. Nonetheless, as a reduced risk biopesticide, polyoxin D zinc salt *is in many ways like an NOP non-synthetic pesticide product*. During the spring 2013 public hearing, Dr. Davis, a former chair of the NOSB Crops Subcommittee, described polyoxin D zinc salt as a "naturally derived fermentation product with a twist."

Especially Low Risk to Humans from Short-Term and Long-Term Exposure

The US Environmental Protection Agency has determined that the polyoxin D zinc salt 5% suspension concentrate formulation (a.k.a. Veggieturbo and Oso) is practically non-toxic via oral, dermal, and inhalation exposure. Also, it is not irritating. The polyoxin D zinc salt 5% SC formulation does not cause eye irritation or skin irritation. The risk from short term exposure is so low that *EPA does not require a first aid statement* for the polyoxin D zinc salt 5% SC formulation.

The US Environmental Protection Agency has determined that the polyoxin D zinc salt has no toxicological end-point to use in a human risk assessment. Polyoxin D zinc salt:

- Does *not* cause genetic damage (is *not* mutagenic);
- Does *not* cause birth defects (is *not* teratogenic);
- Does *not* cause infertility (is *not* a reproductive toxin);
- Does *not* cause cancer (is *not* carcinogenic);
- Does *not* cause adverse effects on the nervous system (is *not* neurotoxic);
- Does *not* cause adverse effects on the immune system (is *not* immunotoxic); and
- Does *not* cause adverse effects in any organ system (is *not* chronically toxic).

Low Environmental Exposure

The polyoxin D zinc salt 5SC formulation is effective at low application rates. The maximum application rate is 13 fl oz formulation/acre (equivalent to *0.045 lb AI/acre*). By comparison:

- Nu Cop 50 WP (EPA Reg. No. 45002-7) containing 77% (w/w) copper hydroxide is applied to grapes at a maximum of 2 lb/acre (equivalent to *1.54 lb AI/acre*; and
- Micro Sulf (EPA Reg. No. 55146-7) containing 80% sulfur is applied to grapes at a maximum rate of 10 lb formulation/acre (equivalent to *8.0 lb AI/acre*).

Therefore, the polyoxin D zinc salt application rate is *significantly lower* (34 times lower and 178 times lower in these examples) than some example OMRI-listed alternative products on an active ingredient basis.

Rapid Environmental Degradation

The US Environmental Protection Agency has determined that the polyoxin D zinc salt degrades rapidly in water and soil under normal environmental conditions. Therefore, polyoxin D zinc salt will not accumulate in the environment. Polyoxin D degrades to a small organic molecule first identified in dog urine. This degradate is absorbed by roots and serves as a crop nutrient.

Low Environmental Risk

The zinc in polyoxin D zinc salt is applied at a micronutrient level that is beneficial to plants.

The US Environmental Protection Agency has determined that polyoxin D zinc salt:

- Is practically non-toxic to birds, algae, honey bees;
- Is moderately toxic to fish and aquatic invertebrates; and
- Does *not* pose a risk to surface water or groundwater when used as directed.

Risk is the product of Hazard and Exposure.

Risk = Hazard x Exposure.

Given the low application rate and rapid degradation rate of polyoxin D zinc salt, *i.e.*, *low environmental exposure*, the US EPA has determined that the polyoxin D zinc salt has *low environmental risk, including for fish and aquatic invertebrates*.

Separately, Kaken has conducted additional studies summarized in the May 31, 2016 petition that have determined that polyoxin D zinc salt, when used as directed, *does not adversely effect*:

- Earthworms;
- Growth or development of ladybird beetles; and
- Beneficial soil fungi.

Its low environmental risk enables polyoxin D zinc salt to play an important role in *integrated pest management (IPM)* programs.

Unique, Non-Toxic Mode of Action and Resistance Management

Polyoxin D zinc salt has a unique, non-toxic mode of action. No other active ingredient registered for use in North America has the same mode of action (FRAC Code 19). This unique, non-toxic mode of action enables polyoxin D zinc salt to play an important role in *resistance management* programs. In 45 years of commercial use, there have been *no reports of pest resistance to polyoxin D zinc salt*.

Grower Need

Based upon *disease economic significance and efficacy data alone*, there is organic grower need for the polyoxin D zinc salt 5SC formulation for treatment of:

- Blueberries for control of:
  - Alternaria blight (*Alternaria* spp.); and
  - Botrytis blight (*Botrytis cinerea*);
- Caneberries for control of:
  - Botrytis fruit rot (*Botrytis cinerea*); and
  - Powdery mildew (*Podosphaera aphanais*);
- Cranberries for control of:
  - Cottonball (Monilinia oxycocci); and
  - Fruit rot complex (*Coleophoma empetri*, *Colletotrichum acutatum*, *Colletotrichum gloeosporioides*, *Phyllosticta vaccinii*, and *Physalospora vaccinii*, etc.);
- Grapes for control of:
  - Phomopsis fruit rot (*Phomopsis viticola*);
- Strawberries for control of:
  - Anthracnose fruit rot (*Colletotrichum acutatum*);
  - Gray mold (*Botrytis cinerea*);
  - Leather rot (*Phytophthora cactorum*); and
  - Phomopsis fruit rot (soft rot) (*Phomopsis obscurans*); and
- Basil for control of:
  - Downy mildew (*Peronospora belbahrii*).

OMRI-listed alternatives initially identified as having comparable or superior efficacy and therefore identified for more detailed comparisons were:

- Blueberries/mummyberry (*Monilinia vaccinii-corymbosi*): Optiva;
- Grapes black rot (*Guignardia bodwellii*): Badge X2 and Nu-Cop 50 WP;
- Grapes/bunch rot (*Botrytis cinerea*): Double Nickel 55 and Double Nickel LC;
- Grapes/downy mildew (*Plasmopara viticola*): Badge X2, Cueva, and Oxidate;
- Grapes/powdery mildew (*Erysiphe necator*): Micro Sulf, Lifegard WG and Stargus; and
- Strawberries/Phomopsis leaf spot (*Phomopsis obscurans*): Cueva.

Based upon more detailed analysis for other crop/disease combinations for berries and small fruits, there is organic grower need for:

- Blueberry/mummyberry control. Compared to Optiva, the polyoxin D zinc salt 5SC formulation offers organic blueberry growers:
  - Competitive efficacy for control of mummyberry;
  - A treatment option *after* mummyberry is first observed;
  - Competitive worker and environmental safety;
  - A reduced risk product with a new non-toxic mode of action for use in resistance management and integrated pest management (IPM); and
  - Opportunities for export of the treated crop to Canada, Mexico, New Zealand, South Korea, Taiwan, and a growing list of additional countries.

- Grape/black rot control. Compared to Badge X2 and Nu-Cop 50 WP, the polyoxin D zinc salt 5SC formulation offers organic grape growers:
  - Competitive efficacy for control of black rot;
  - Greater crop, worker, and environmental safety;
  - An opportunity to reduce the amount of copper applied to their vineyards and thereby reduce the negative effects of copper on soil;
  - Reduced (EPA's minimum) personal protective equipment requirement;
  - Greater flexibility in growing the crop (0-day PHI instead of 1-day; 4-hour worker re-entry interval instead of 48-hours or 24-hours);
  - A reduced risk product with a new non-toxic mode of action for use in resistance management and integrated pest management (IPM); and
  - Opportunities for export of the treated crop to Canada, Mexico, New Zealand, South Korea, Taiwan, and a growing list of additional countries.

- Grape/bunch rot control. Compared to Double Nickel 55 and Double Nickel LC, the polyoxin D zinc salt 5SC formulation offers organic grape growers:
  - Competitive or superior efficacy for control of bunch rot;
  - A treatment option *after* bunch rot is first observed;
  - Competitive worker and environmental safety;
  - A reduced risk product with a new non-toxic mode of action for use in resistance management and integrated pest management (IPM); and
  - Opportunities for export of the treated crop to Canada, Mexico, New Zealand, South Korea, Taiwan, and a growing list of additional countries.

- Grape/downy mildew control. Compared to Badge X2, Cueva, and Oxidate, the polyoxin D zinc salt 5SC formulation offers organic grape growers:
  - Competitive or superior efficacy for control of downy mildew;
  - An opportunity to reduce the amount of copper applied to their vineyards and thereby reduce the negative effects of copper on soil;
  - Greater to significantly greater crop, worker, and environmental safety;
  - Reduced (EPA's minimum) personal protective equipment requirement;
  - Greater flexibility in growing the crop [0-day PHI instead of 1-day PHI; 4-hour worker re-entry interval instead of 48 hours (Badge X2)];
  - A reduced risk product with a new non-toxic mode of action for use in resistance management and integrated pest management (IPM); and
  - Opportunities for export of the treated crop to Canada, Mexico, New Zealand, South Korea, Taiwan, and a growing list of additional countries.

- Grape/powdery mildew control. Compared to Micro Sulf, Lifegard WG and Stargus, the polyoxin D zinc salt 5SC formulation offers organic grape growers:
  - Competitive or superior efficacy for control of powdery mildew;
  - A treatment option *after* powdery mildew is first observed;
  - An opportunity to reduce the amount of copper applied to their vineyards and thereby reduce the negative effects of copper on soil;
  - Competitive or superior crop, worker, and environmental safety;
  - Greater flexibility in growing the crop [0-day PHI instead of 1-day PHI; 4-hour worker re-entry interval instead of 48 hours (Badge X2)];
  - Increased applicator comfort (no respirator is required as is required for Lifegard WG and Stargus);
  - A reduced risk product with a new non-toxic mode of action for use in resistance management and integrated pest management (IPM); and
  - Opportunities for export of the treated crop to Canada, Mexico, New Zealand, South Korea, Taiwan, and a growing list of additional countries.

- Strawberry/Phomopsis leaf spot (blight). Compared to Cueva, the polyoxin D zinc salt 5SC formulation offers organic strawberry growers:
  - Competitive efficacy for control of Phomopsis leaf spot;
  - A treatment option *after* Phomopsis leaf spot is first observed;
  - Competitive or superior crop, worker, and environmental safety;
  - A reduced risk product with a new non-toxic mode of action for use in resistance management and integrated pest management (IPM);
  - Opportunities for export of the treated crop to Canada, Mexico, New Zealand, South Korea, Taiwan, and a growing list of additional countries.

Please note:

- For scheduling reasons, the grower needs analysis is limited to berries and small fruits and basil. Similar results are anticipated if other crop/disease combinations were analyzed.
- There is no EPA registered, OMRI-listed alternative for treatment of cranberries for control of cottonball (*Monilinia oxycocci*).

Compatibility with OMRI-Listed Alternative Products

The polyoxin D zinc salt 5SC formulation, when added to a treatment program, provides *superior control* of blueberry mummyberry fruit infections (fruit strikes) than when the following products are used alone:

- Actinovate (containing *Streptomyces lydicus* WYEC 108; no FRAC Code; biological);
- Double Nickle LC (containing *Bacillus amyloliquefaciens* strain 747; FRAC Code 44);
- Regalia (containing *Reynoutria sachalinensis* extract; FRAC Code P5), and
- NovaSource's Lime-Sulfur (containing calcium polysulfide; FRAC Code M2).

Kaken does *not* recommend the use of polyoxin D zinc salt as a tank-mix partner or as part of a treatment program with products containing *Trichoderma* fungi (Bio-Tam and RootShield).

No Non-Synthetic Alternative

For a pesticide product to be used in the United States, it must be registered by the U.S. Environmental Protection Agency (US EPA). The registration includes detailed descriptions of the starting materials, production process, and final product specifications plus a large volume of human and environmental safety data. These details are fixed for polyoxin D zinc salt.

Polyoxin D (without the zinc) is *not* a non-synthetic alternative to polyoxin D zinc salt. Polyoxin D (without the zinc) is *not* a US EPA registered pesticide. The time and expense of pursuing such a registration would be prohibitive. Even if this were not the case, commercially significant efficacy would first need to be demonstrated.

Crop Residue and Export Considerations

The US EPA has established a tolerance exemption for residues of polyoxin D zinc salt for all crops (pre-harvest and post-harvest) treated according to good agricultural practice (40 CFR §180.1285).

Crops grown in the United States using the polyoxin D zinc salt 5SC formulation according to the US EPA registered label may be exported to:

- Canada;
- Mexico;
- New Zealand;
- South Korea; and
- Taiwan.

These countries have made similar low risk determinations for polyoxin D zinc salt and have enacted regulations that are similar to EPA's tolerance exemption. Numerical maximum residue limits (MRLs) have not been established.

Kaken is pursuing additional imported crop authorizations for polyoxin D zinc salt that are similar to the US EPA's tolerance exemption. Applications to permit importation of crop commodities treated with polyoxin D zinc salt are pending or in preparation. The list of pending applications include the European Union.

Cultural Practices

Kaken proposes that the inclusion of the allowed synthetic active ingredients listed in 7 CFR §205.601(i), by itself, is evidence that cultural practices alone are *not* sufficient to address organic grower needs.

Use of Polyoxin D Zinc Salt as Part of Resistance Management Programs and Integrated Pest Management (IPM) Programs

In the efficacy trials, the polyoxin D zinc salt 5SC formulation was applied application after application. This is an *artificial* design to demonstrate efficacy for each crop/disease combination. Kaken intends that the polyoxin D zinc salt 5SC formulation, when used commercially, will be:

- Rotated and/or tank-mixed with other products with different modes of action; and
- Part of thoughtfully designed resistance management programs and integrated pest management (IPM) programs.

Level Playing Field

Kaken proposes that the National Organic Standards Board and the National Organic Program should have a level playing field when considering proposed additions to the list of synthetic substances allowed for use in organic crop production. The criteria used in the evaluation of polyoxin D zinc salt should be no more restrictive than those applied to the synthetic substances currently listed in 7 CFR §205.601(i) as permitted in organic agriculture for use on crops as plant disease control.

INTRODUCTION

On May 31, 2016, Kaken Pharmaceutical Co., Ltd. to the National Organic Program (NOP) a Petition to Amend 7 CFR §205.601 to Add Polyoxin D Zinc Salt as a Synthetic Substance Allowed for Use In Organic Crop Production (May 31, 2016).

The purpose of this addendum is to update the May 31, 2016 petition to:

- Propose new uses for organic growers consistent with the January 3, 2018 EPA stamped accepted label; and
- Provide:
  - The most recent stamped accepted label for VEGGIETURBO 5SC Suspension Concentrate Fungicide (EPA Reg. No. 68173-4; January 3, 2018);
  - Summaries of new efficacy data for the polyoxin D zinc salt 5SC formulation;
  - Summaries of published efficacy data for US EPA registered OMRI-listed alternative products;
  - An update regarding international regulatory approvals for imported crop commodities; and
  - An updated rationale for approval of the petition.

US EPA STAMPED ACCEPTED LABEL

The current label for Veggieturbo 5SC Suspension Concentrate Fungicide was stamped Accepted by the US EPA on January 3, 2018 and includes many new uses. Please see Appendix 1 for a copy of the EPA stamped accepted label.

NEWLY PETITIONED USES

The proposed new uses of the polyoxin D zinc salt 5SC formulation for use in organic production are use on:

- Grapes for treatment of:
  - Black rot (*Guignardia bodwellii*);
  - Downy mildew (*Plasmopara viticola*); and
  - Phomopsis fruit rot (*Phomopsis viticola*);
- Strawberries for treatment of:
  - Anthracnose fruit rot (*Colletotrichum acutatum*);
  - Leather rot (*Phytophthora cactorum*);
  - Phomopsis leaf spot (blight) (*Phomopsis obscurans*); and
  - Phomopsis fruit rot (*Phomopsis obscurans*); and
- Basil for treatment of:
  - Downy mildew (*Peronospora belbahrii*).

CROP GROUP 13: BERRIES AND SMALL FRUITS: GRAPES: Black rot (*Guignardia bidwellii*)

Economic Importance
(Source: 2015 Organic Production and IPM Guide for Grapes. Cornell University Cooperative Extension.)

Black rot is one of the most serious diseases of grapes in the eastern United States and has the potential to be the "Achilles heel" for organic producers. Fruit rot is the most damaging phase of the disease, but all green tissues of the vine are susceptible to infection. This disease can be especially damaging in organic production because organic-approved fungicides are largely ineffective. Therefore, strict implementation of sanitation practices and other available horticultural techniques is essential, especially on moderately to highly susceptible varieties. Black rot can cause complete crop loss in warm, wet years if it is not properly managed.

Biology
(Source: 2015 Organic Production and IPM Guide for Grapes. Cornell University Cooperative Extension.)

Infected leaves develop relatively small, brown circular lesions surrounded by distinct dark margins; black, pimplelike fruiting bodies ("pycnidia") are scattered within these spot-like lesions. Black, elongated lesions on petioles (leaf stems) may cause affected leaves to wilt and drop. Large, black, elliptical lesions on infected shoots may contribute to breakage by wind. The disease is most common and damaging on berries which appear chocolate brown when first infected, but soon become dark brown with numerous black, pimple-like pycnidia on the surface. Berries eventually shrivel into hard, black raisin-like mummies, most of which remain firmly attached to the berry stem. The black rot fungus overwinters primarily in these mummified fruit, either on the vineyard floor or in clusters retained within the vine. It can also overwinter within cane lesions when these develop.

Rain triggers the release of infective spores from all sources, and infection occurs if susceptible tissues remain wet for a sufficient length of time, which depends on temperature.

Hours of Leaf Wetness Required for a Black Rot Infection Period At Various Temperatures Following a Rain (Source: R. A. Spotts. 1977. The Ohio State University.)	
Temperature (°F)	Hours of Continual Wetness from Rain
50	24
55	12
60	9
65	8
70	7
75	7
80	6
85	9
90	12

Spores within cane lesions are available for infection starting at bud break. However, the majority of overwintering spores in most vineyards (those within mummified fruit on the ground) first become available about 2–3 weeks after bud break, reach peak levels about 1–2 weeks before bloom, and are usually depleted within one to several weeks after the start of bloom, depending on the season. However, in years with dry spring weather when only a few rains occur, the fungus does not discharge all of its spores as early as usual, and significant spore discharge may extend several weeks beyond bloom if this is when rains finally develop.

Pycnidia develop within lesions caused by current season infections and release a new crop of spores during the late spring and summer, beginning about 2–3 weeks after infection first occurs. These secondary rounds of spore release and infection are responsible for disease spread and are the cause of most economic loss when it occurs. Fruit are highly susceptible to infection for the first 2–3 weeks after bloom. They become progressively less susceptible as they continue to develop, finally becoming highly resistant about 5–8 weeks after bloom, depending on the variety and year. In general, "Concord" fruit appear to become resistant about 1–2 weeks earlier than those of Vinifera varieties. Thus, the most critical time to control berry infections is during the first few weeks after the start of bloom.

Cultural Control
(Source: 2015 Organic Production and IPM Guide for Grapes. Cornell University Cooperative Extension.)

Removal of mummified clusters from the canopy during pruning significantly reduces disease pressure for the coming season; burying mummies on the ground before or soon after budbreak, by cultivation or covering them with mulch, also can contribute to a reduction of inoculum if disease was severe the previous season. **CAUTION:** When mummified fruit are not dropped to the ground during dormant pruning operations, large numbers of spores will be produced within the canopy throughout the period of berry development. Research has shown that this prolonged period of high spore production, combined with the closeness of the spores to newly-developing berries, significantly increases the pressure for berry rot. *Therefore, complete removal of mummies from the canopy is an absolutely critical component of a black rot management program for organic growers.* (Emphasis added.)

All fungicides currently approved for organic production are weak against black rot, although copper has moderate efficacy if applied very regularly. Therefore, growers of organic grapes should pay strict attention to the above sanitation procedures, because they are the most important defenses against this disease, which can be the "Achilles heel" of organic grape production in eastern viticulture. Cultural practices that open the canopy also are beneficial because they promote drying and improve spray coverage.

Management Options

Management Options (Source: 2015 Organic Production and IPM Guide for Grapes. Cornell University Cooperative Extension.)	
Scouting/thresholds	Severe loss is usually the result of disease spread within and among clusters after it first gets established on a few berries in the early stages of fruit development. Scout for symptoms of black rot regularly beginning 10 days to 2 weeks after cap fall. Remove diseased clusters and/or consider regular copper applications during wet weather periods on varieties where this material can be used, especially if more than a trace level of disease is found.
Slightly susceptible varieties	Cascade, Cayuga White, Chancellor, Chelois, Corot noir, DeChaunac, Elvira, GR7, Ives, Marquette, Noiret, Traminette, Vidal blanc, and Vignoles.
Cultural management	*Sanitation*. Remove all mummies from the canopy and drop to the ground during dormant pruning operations. Around bud break, cultivate beneath the vines to bury mummies or cover them with mulch. *Canopy management*. Prune and train the vines to promote air circulation and speed drying of the leaves and fruit. Establish new plantings away from wooded areas, where wild grapes can serve as a source of black rot spores.
Chemical treatment	Copper products on varieties not sensitive to this material.

2016 IR-4 Grower Priority

The most recent IR-4 Workshop for prioritization of research to address grower needs for disease control was held September 21, 2016 in Orlando, FL. Black rot control on grapes was identified as a grower need for prioritization (organic category *and* fruit category).

CROP GROUP 13: GRAPES: Downy mildew (*Plasmopara viticola*)

Economic Importance
(Source: Ash, G. Downy Mildew of Grape. 2000. *The Plant Health Instructor*. DOI: 10.1094/PHI-I-2000-1112-01. Updated 2005.)

Downy mildew is a highly destructive disease of grapevines in all grape-growing areas of the world where there is spring and summer rainfall at temperatures above 10° C (50° F). Crop losses in individual years can be 100% if the disease is not controlled during favorable weather. Early infection of young bunches can lead to significant crop loss, whereas, severe leaf infection affects the source-sink relationship in the vine and may lead to defoliation and possible sunburn or lack of fruit ripening. This destruction of leaf tissue may affect sugar accumulation and growth in the subsequent season. Currently, there are no suitable sources of resistance in commercially acceptable varieties, so fungicides are the primary means of disease control.

Biology
(Source: 2015 Organic Production and IPM Guide for Grapes. Cornell University Cooperative Extension.)

Downy mildew is caused by a fungus-like organism that can infect berries, leaves, and young shoots. Leaf lesions appear as yellow or reddish-brown areas on the upper surface, with corresponding white, downy, or cottony fungal growth directly opposite on the lower surface. (Note that downy mildew growth appears only on the lower surface of a leaf lesion and looks cottony, whereas powdery mildew can occur on both sides of the lesion and looks more like baby powder). Leaf lesions become brown and dead with age, and severely infected leaves fall prematurely. Young, infected shoots and cluster stems may curl and are characteristically covered with the white, "downy" growth of the fungus on mornings following rain or dew the night before. Berries on infected cluster stems may fail to set or can turn brown and eventually shrivel, depending on the time of infection. Berries that are directly infected while very young may become entirely covered with a fuzzy white fungal growth when wet from evening rain or early morning dew. Cluster infections that occur later in the season cause berries to remain hard, with a mottled light green to brown or red appearance.

Frequent rainfall and high humidity are the most important environmental factors promoting downy mildew epidemics. The downy mildew organism overwinters as dormant spores within infected leaves on the vineyard floor or (more commonly) within the upper soil layer, and first becomes active in the spring about 2–3 weeks before bloom. Infective spores are then produced during rainy periods if temperatures are above 52°F, and are splashed from the soil onto susceptible tissues to cause the season's first (primary) infections. (Note that inoculum for such early-season infections come strictly from within the vineyard.) Epidemic disease development can then result from repeated cycles of new infections, which are caused by new spores produced within the white fungal growth on diseased tissues. These spores are produced only at night when the relative humidity is extremely high (>95%). They can be blown relatively long distances and cause infection when they land on susceptible tissues that remain wet for just a few hours. (Note that such disease spread can also originate from nearby vines outside the vineyard.)

The generation period for the fungus (time from spore germination and infection to the production of a new "crop" of secondary spores) is only 4 to 5 days at optimum temperatures in the mid- to upper-70s, allowing explosive disease development during extended periods of warm, humid weather with periodic rain showers. On some varieties, including all Vinifera varieties, this can be particularly destructive during the several week period before and after bloom, when fruit clusters are highly susceptible to infection. Young leaves remain highly susceptible to infection so long as they continue to be produced, although even older leaves can become diseased under high-pressure conditions. Uncontrolled infections can cause extensive defoliation in wet years, limiting both fruit ripening and

vine winter hardiness. Winter kill of buds or even entire vines is not uncommon when spraying stops too early on susceptible varieties in a bad downy mildew season. Disease can develop at a wide range of temperatures, from the low 50s to the mid-80s, although the rate of spread is slower while at the edges of the range.

Management
(Source: 2015 Organic Production and IPM Guide for Grapes. Cornell University Cooperative Extension.)

Downy mildew management programs should focus on:

- Preventing early disease establishment and destructive cluster infections during the pre-bloom and early post-bloom periods; and
- Limiting secondary spread on the foliage during the summer and early fall.

Any practice that improves air circulation and speeds drying within vine canopies will help to control downy mildew.

Because primary infections can first occur 2–3 weeks before bloom, protection may need to start at this time on Vinifera varieties and on highly susceptible hybrid and Labrusca varieties (e.g., Chancellor, Catawba, Niagara) if the weather is wet. This is particularly true if significant disease occurred the previous year which would contribute to high levels of overwintering inoculum within the vineyard. Clusters should be protected on all but the most highly resistant varieties from the immediate pre-bloom period through the first or second post-bloom spray, depending on the weather.

Continued protection against disease spread during the summer should be based on variety susceptibility, the extent of favorable weather conditions, and the amount of disease already in the vineyard (secondary inoculum). Downy mildew has the potential for "explosive" spread if the disease is active and weather conditions favor its development. However, in many years, hot, drier weather causes the downy mildew fungus to become inactive during mid-summer. Thus, it is worthwhile to scout vineyards during this time for the presence of active disease and to determine the need for protective sprays based on such findings. Also, recognize that fruit lose their susceptibility to infection by midsummer, although protection against leaf infections and consequent defoliation may need to continue throughout the summer, depending on weather conditions.

Downy Mildew Management Options (Source: 2015 Organic Production and IPM Guide for Grapes. Cornell University Cooperative Extension.)	
Scouting/thresholds	Scout vineyards in mid-summer for the presence of sporulating lesions that may spread infections to leaves during warm, wet weather.
Slightly susceptible varieties	Baco noir, Cascade, Chelois, Concord, Foch, Frontenac, Frontenac gris, Himrod, Marquette, Moore's Diamond, Steuben, and Valvin Muscat.
Cultural management	*Canopy management*. Prune and train the vines to promote air circulation, reduce humidity, and speed drying of the leaves and fruit. *Vineyard management*. Orient rows to improve air movement within the vineyard. Avoid sites prone to fog or heavily wooded areas.
Chemical treatment	Copper products are very effective, although they must be reapplied frequently (7-day to 10-day intervals) during periods of wet weather to provide continued protection.

2016 IR-4 Grower Priority

The most recent IR-4 Workshop for prioritization of research to address grower needs for disease control was held September 21, 2016 in Orlando, FL. Downy mildew control on grapes was identified as a grower need for prioritization (fruit category).

CROP GROUP 13: GRAPES: Phomopsis Fruit Rot (*Phomopsis viticola*)

Economic Importance
(Source: Wayne F. Wilcox, Grape Disease Control, 2015. Cornell University.)

Wayne F. Wilcox of Cornell University reported that over the years, he believes he has seen Phomopsis cause more pronounced economic loss on Concord and (especially) Niagara grapes than any other disease. Most hybrid and *V. vinifera* cultivars are susceptible as well, and whereas they tend to be less problematic in the vast majority of these commercial blocks for several reasons, that does not have to be true.

Biology
(Source: 2015 Organic Production and IPM Guide for Grapes. Cornell University Cooperative Extension.)

Phomopsis cane and leaf spot and fruit rot are most likely to become problems when the Phomopsis fungus is allowed to build up on dead canes or pruning stubs in the vines and effective early-season sprays for this disease are omitted. In conventionally managed vineyards, economic losses have been especially severe on Niagara, and to a lesser extent, Concord, although many other Labrusca, hybrid, and Vinifera varieties are susceptible as well.

Infected rachises and shoots develop black lesions that may split the green tissue (shoots) or appear sunken (rachises). Numerous lesions give the shoot surface a blackened, scabby appearance, and may coalesce to girdle the rachises. Severe infection weakens the tissues at these spots and can cause infected shoots to break off during high winds, or infected clusters to break before and during harvest. Small, pinprick-sized lesions, with brown or black centers surrounded by a small and often yellow margin, can be numerous on the leaves early in the season. These infections cause little harm themselves, but provide a good indication that the fungus is present in the vine and capable of causing more serious losses on other organs if not effectively managed.

Infected berries remain symptomless until late summer or pre-harvest, when they turn brown, often beginning at the point of attachment to the pedicel (berry stem) and become covered with black, pimple-like fruiting bodies. Such berries eventually shrivel up into raisin-like "mummies", at which time they look very similar to berries infected with black rot. On fruit, the two diseases are best distinguished by the initial location, timing, and development of symptoms. Phomopsis lesions typically (but not always) start where the berry is attached to its stem, whereas black rot lesions start at random locations on the fruit. Also, Phomopsis lesions do not appear until late summer or early fall on the fruit, often just before harvest. In contrast, most black rot symptoms appear by late July or early August, and all diseased berries should be evident by veraison. Finally, berries infected with Phomopsis are usually quite easy to detach from their stem by lightly touching them or giving a gentle pull, whereas those with black rot typically remain attached firmly to the berry stem.

Black fruiting bodies of the Phomopsis fungus overwinter in infected wood (diseased canes or pruning stubs) and rachises. During wet periods, spores ooze from the fruiting bodies and are distributed by raindrops onto nearby susceptible tissues. For this reason, young shoots and clusters directly beneath old canes and pruning stubs are at greater risk than those that are trained to grow above these sources.

Extended periods of wet weather are particularly favorable for disease development. Shoot and leaf infections can occur anytime between bud break and early summer, although they are most common during the first few weeks of growth. Shoot and leaf lesions appear within 3 to 4 weeks after infection, but they do not serve as a source of disease spread during the current season. Rachises can be infected anytime after the young clusters first emerge until fungal spores are depleted in early

summer, although infections that occur soon after cluster emergence in the early growing season are the most damaging. Infections that occur on the pedicels (berry stems) during this period can also move into the fruit, causing them to rot before harvest.

Fruit appear to be most susceptible to direct infection from bloom through pea-sized berries, after which few spores are available for new infections. Fruit infection occurs sporadically, since it requires extended periods of rain and wetness. However, serious losses can result if the growing season is excessively wet and protection is not maintained with an effective Phomopsis fungicide from the early shoot growth period through fruit set.

Disease Management
(Source: 2015 Organic Production and IPM Guide for Grapes. Cornell University Cooperative Extension.)

Diseased canes should be removed during pruning to reduce inoculum. Research has shown that dead canes and pruning stubs can produce extremely high levels of Phomopsis spores, and these sources should be specifically targeted for removal as part of a Phomopsis management program. Recent research from Ohio suggests that when inoculum is present, moderately-severe infection can develop after about 26 hours of wetness at an average temperature of 48°F, 16 hours at 54°F, and 12 hours at 60–68°F (shorter and longer periods of wetness should reduce and increase disease severity, respectively).

Copper and sulfur are only weakly effective; thus, organic growers should pay strict attention to the removal of infected wood from within the canopy.

Phomopsis Management Options (Source: 2015 Organic Production and IPM Guide for Grapes. Cornell University Cooperative Extension.)	
Scouting/thresholds	Note “hot spots” of disease activity within individual vines; try to identify the likely source of the fungus causing these infections (pruning stubs, dead canes) and target for removal.
Slightly susceptible varieties	Baco Noir, Cayuga White, Elvira, GR7, Marquette, Marquis, Vanessa, Ventura, and Vidal blanc.
Cultural management	*Sanitation*. Remove all dead wood, infected wood and pruning stubs from the canopy during dormant pruning operations. *Canopy management*. Prune and train the vines to promote air circulation and speed drying of the shoots and clusters. In some instances performing “cane pruning” rather than “spur or cordon pruning” in vinifera and hybrids will result in ensuring new wood is laid down on the fruiting wire every year. *Vineyard management*. Orient rows to improve air movement within the vineyard.
Chemical treatment	*Copper and sulfur are weakly effective and may cause injury on sensitive varieties.* Early-season copper use may also injure more tolerant varieties if applied under cool and/or humid, slow-drying conditions. (Emphasis added.)

2016 IR-4 Grower Priority
The most recent IR-4 Workshop for prioritization of research to address grower needs for disease control was held September 21, 2016 in Orlando, FL. Phomopsis control on grapes was identified as a grower need for prioritization (fruit category).

CROP GROUP 13: STRAWBERRIES: Anthracnose Fruit Rot (*Colletotrichum acutatum*)

Economic Importance
(Source: Averre, C.W., Jones, R.K., and Miholland, R.S., Strawberry Diseases and Their Control, North Carolina State Extension)

Anthracnose fruit rot (*Colletotrichum acutatum*) can be a very destructive disease on California cultivars grown on black plastic. It has been reported to cause 60-75% fruit loss. The disease is most destructive during warm, wet weather. During warm wet periods, on a highly susceptible cultivar such as Pajaro or Chandler, anthracnose can be extremely difficult to control.

Pathogens
(Source: Strawberry Anthracnose. U Massachusetts Extension. A. Madeiras, 2016)

Anthracnose is a general term for diseases caused by species of the fungus *Colletotrichum*. In the Northeast, anthracnose of strawberries is caused by *Colletotrichum acutatum*, which can infect all parts of the plant. *Colletotrichum acutatum* has become increasingly troublesome since it was first identified in the US in 1986. Fruit rot is of particular concern as the fruit is rendered unmarketable. *Colletotrichum fragariae* and *Colletotrichum. gloeosporioides* are more commonly associated with a lethal crown rot, but these species are more common in warmer climates. *Colletotrichum acutatum* is endemic in the Northeast, but may also be brought in on infected transplants.

Signs and Symptoms
(Source: Strawberry Anthracnose. U Massachusetts Extension. A. Madeiras, 2016)

All three *Colletotrichum* species associated with strawberry anthracnose can cause leaf spots and/or dark lesions on petioles and stolons, crown infections, flower blight, and fruit rot. Leaf spots caused by *Colletotrichum acutatum* are brown to black and often more numerous along leaf tips and margins. The spots differ somewhat from the randomly distributed gray to black spots caused by *Colletotrichum fragariae* or *Colletotrichum gloeosporioides*. Petioles and stolons may become girdled, causing death of leaves and daughter plants. Open flowers are more susceptible to blight than closed buds.

Anthracnose can also affect fruit at any stage of development from flowering to harvest. On fruit, symptoms may begin as small light colored or water-soaked lesions a few millimeters in diameter. These lesions grow progressively larger and darker as they mature and end as sunken black spots. After a few days, salmon-colored masses of conidia appear in the lesions. Fruit may eventually become shrunken and mummified. Crowns infected by *Colletotrichum* species will be firm and reddish-brown inside. The discoloration may be uniform or show light and dark brown streaks. *Colletotrichum acutatum* is capable of causing crown infections, but plants usually survive, remain stunted, and produce few berries. Crown infections may occur in the nursery, but can remain latent until well after planting. *Colletotrichum acutatum* can also cause root lesions.

Life Cycle
(Source: Strawberry Anthracnose. U Massachusetts Extension. A. Madeiras, 2016)

Colletotrichum acutatum survives winter in plant debris, particularly mummified fruit. Primary inoculum is produced in spring. The optimum temperature for disease development is about 27°C (80°F). However, the fungus can infect fruit at lower temperatures, and spring infections may remain latent until warm, wet conditions induce disease development. Lesions produce conidia that may continue the infection process throughout the growing season. The time from infection to first sporulation is 7-11 days at 5°C and 2-3 days at 25°C. The fungus can produce conidia at temperatures from 5-35°C, though production is most abundant at 22-26°C. An adequate period of surface

wetness is also required for infection. At 25-30°C, infection occurs in less than 24 hours, but at lower temperatures, a longer wetness period is required. Spores are most often spread by splashing rain, but they may also be transported by insects, animals, and farm workers. Although *Colletotrichum acutatum* has a wide host range that includes many fruit, vegetable, and weed species, research suggests that strains of *Colletotrichum acutatum* that are pathogenic on strawberries are relatively host specific.

Management

Strawberry/Anthracnose Management Options (Source: 2016 Organic production and IPM Guide for Strawberries, Cornell Cooperative Extension)	
Scouting/Thresholds	None established.
Variety susceptibility	No known resistance varieties. 'Jewel' shows little infection in field conditions.
Cultural management	• Provide good air circulation by controlling weeds and reducing planting density. • Use of protected production structures, such as low tunnels, reduces anthracnose occurrence by limiting fruit wetness. • The anthracnose fungus is spread throughout a planting by splashing raindrops or sprinkler irrigation. Straw mulch may reduce the rate of disease spread relative to bare ground (less rain splash).
Chemical treatment	See table below.

(Source: Strawberry Anthracnose. U Massachusetts Extension. A. Madeiras, 2016)

Both organic and conventional fungicides are more effective when applied preventatively. OMRI approved products include Cease (*Bacillus subtilis* QST 713), which has been shown to provide some protection from fruit rot. Copper and sulfur based compounds are also available. However, neither is very effective for anthracnose control and both can be phytotoxic under certain conditions.

CROP GROUP 13: STRAWBERRIES: Leather Rot (*Phytophthora cactorum*)

Economic Importance
(Source: Leather Rot of Strawberry, Michael A. Ellis, Department of Plant Pathology, Ohio State University Extension)

Leather rot of strawberry has been reported in many regions of the United States. In many areas, it is considered a minor disease of little economic importance. However, excessive rainfall during May, June and July can lead to severe losses in fruit yield and quality resulting from leather rot. Commercial growers in Ohio have lost up to 50 percent of their crop to leather rot. The leather rot fungus primarily attacks the fruit, but many also infect blossoms.

(Source: Leather Rot of Strawberry, NC State Extension, https://content.ces.ncsu.edu/leather-rot-of-strawberry)

Leather rot, caused by *Phytophthora cactorum*, may cause substantial losses of fruit yield in wet years, and is particularly troublesome for pick-your-own operations, where undetected diseased fruit mixed in with healthy fruit may result in bitter tasting jams and jellies. Leather rot has been recorded only once since 1997 in plasticulture systems but may be a problem in matted row systems. *Phytophthora* spp. may also cause crown rot of strawberry, although these two diseases do not necessarily occur together.

Description
(Source: 2016 Organic Production and IPM Guide for Strawberries, Cornell Cooperative Extension)

Leather rot is caused by *Phytophthora cactorum*. Infected areas on immature fruit are brown, whereas those on maturing fruit appear bleached out. On all fruit, the infected areas are tough, leathery, and discolored on the inside as well as the outside of the fruit. Diseased fruits have a pungent smell and bitter taste. Leather rot is most severe during periods of abundant warm rains during the fruiting period and in flooded soils. The cultural practices listed in the table below are the most effective control procedures.

Management Options
(Source: 2016 Organic Production and IPM Guide for Strawberries, Cornell Cooperative Extension)

Leather Rot Management Options	
Scouting/thresholds	None established.
Variety susceptibility	No known resistant varieties.
Cultural management	• Plant only on a well-drained site or provide supplemental drainage. Growing strawberries on raised beds will also reduce disease severity. • Minimize soil flooding through site selection; by avoiding planting in ruts; and by preventing or reducing soil compaction. • Provide an extra layer of straw mulch between rows throughout the fruiting season. The mulch provides a physical barrier between the soilborne pathogen and the susceptible fruit.

Listing a pest on a pesticide label does not assure the pesticide's effectiveness.

CROP GROUP 13: STRAWBERRIES: Phomopsis Leaf Spot/Blight and Fruit Rot (Soft Rot) (*Phomopsis obscurans*)

Economic Importance
(Source: N. A. Peres, 2015 Florida Plant Disease Management Guide: Strawberry, Univ. of Florida IFAS Extension)

Phomopsis leaf blight and Phomopsis soft rot, caused by *Phomopsis obscurans*, can occasionally cause serious problems on strawberry, especially on plants propagated in nurseries from the southeastern United States.

Biology
(Source: 2016 Organic Production and IPM Guide for Strawberries, Cornell University Cooperative Extension)

Leaf lesions begin as small, circular to irregular, reddish, or purplish spots. As they expand, lesion centers become necrotic and turn light brown with a dark purple halo. Older lesions along major leaf veins develop into large V-shaped lesions that eventually kill the leaf. Heavy leaf infections can inhibit the production of flower buds for the following year, predispose a plant to winter injury, and provide inoculum for infection of the fruit caps. Fruit may also be infected in some instances.

Management Options

Phomopsis Leaf Blight (*Phomopsis obscurans*) Management Options (Source: 2016 Organic Production and IPM Guide for Strawberries, Cornell University Cooperative Extension)	
Scouting/thresholds	None established
Variety susceptibility	There are no reports of cultivar resistance to leaf blight but Jewel shows low infection rates.
Cultural management	Destroying infected leaves at renovation (e.g., mowing and burying) will reduce the amount of carry-over inoculum. Promoting air circulation (plant spacing and weed control) will reduce foliage drying time and limit infection periods.
Chemical treatment	An early season fungicide application is recommended when carry-over inoculum from the previous year is high or conditions are favorable for disease development.

Listing a pest on a pesticide label does not assure the pesticide's effectiveness.

CROP GROUP 19: HERBS AND SPICES

CROP GROUP 19: BASIL: Downy Mildew (*Peronospora belbahrii*)

Economic Importance
[Source: Michelle Grabowski, Basil Downy Mildew, University of Minnesota Extension. (Not dated.)]

Basil downy mildew was first officially identified in Minnesota in 2012. Under the right weather conditions, basil downy mildew can spread rapidly and result in complete yield loss. Although *Peronospora belbahrii*, the pathogen that causes basil downy mildew, cannot survive MN's winters, it can be reintroduced on infected seed or transplants or by windblown spores.

Identification
[Source: Michelle Grabowski, Basil Downy Mildew, University of Minnesota Extension. (Not dated.)]

- Infected leaves first turn yellow in areas restricted by major veins. With time, the entire leaf turns yellow.
- Irregular black spots appear on infected leaves as they age.
- Fluffy gray spores grow on the underside of infected leaves.
- Infection starts on lower leaves and moves up the plant.

Biology
[Source: Michelle Grabowski, Basil Downy Mildew, University of Minnesota Extension. (Not dated.)]

Peronospora belbahrii, the pathogen that causes basil downy mildew, can be carried on seed, transplants, or fresh leaves. Infected transplants and leaves may not show symptoms if maintained in cool dry conditions. Spores of *Peronospora belbahrii* can also travel long distances on moist air currents. *Peronospora belbahrii* tolerates cool weather and can infect and produce spores in temperatures as low as 59°F. The pathogen, however, thrives in warm, humid conditions. As a result, the most devastating damage is often seen in late summer.

Peronospora belbahrii needs two different mating types to produce tough resting spores known as oospores. Currently, only one mating type has been found in the USA. As a result, no oospores are formed, and the pathogen will not be able to survive Minnesota's harsh winters. This may change if the second mating type is introduced.

Management
[Source: Michelle Grabowski, Basil Downy Mildew, University of Minnesota Extension. (Not dated.)]

Resistant Varieties
There are no resistant varieties of sweet basil (*Ocimum basilicum*) available. Commercially popular varieties are highly susceptible. Lower disease levels have been observed in red leaf basil varieties (*Ocimum basilicum purpurescens*) and in lemon flavored varieties (*Ocimum citridorum*). Only varieties of *Ocimum americanum* have shown no symptoms or sporulation when inoculated with downy mildew.

Varieties with no to low disease are not necessarily good substitutes for susceptible sweet basil varieties. They often have different leaf color and flavor, dramatically affecting the final product. Growers should choose the most resistant variety that is acceptable to their market. Breeders are working to combine the flavor and other characteristics of sweet basil with the resistance found in other species of *Ocimum*.

Cultural Control

Peronospora belbahrii is carried on seed. All seedlings and transplants should be monitored closely for yellowing leaves and gray downy growth on the lower surface of the leaf. If basil downy mildew is identified on any plant, it should be removed and destroyed immediately.

Increase row width and distance between plants to provide good air movement between plants to allow leaves to dry quickly after rain, dew or irrigation. Use drip irrigation if possible. If sprinkler irrigation is the only option, water deeply and infrequently early on a sunny day so leaves dry quickly in the sun. In greenhouse production, adjust ventilation to reduce humidity.

Diseased plants that are past harvest should be promptly tilled under to reduce the spread of the pathogen from one plant to another through spores produced on infected leaves.

Fungicides

Certain fungicides can protect plants from basil downy mildew but sprays must begin before infection occurs to be effective. *Peronospora belbahrii* is not a true fungus but rather a member of the Oomycota. As a result, many common fungicides provide no control against downy mildew. In one study, extreme periods or rainy wet weather resulted in no control by any fungicide combination.

2016 IR-4 Grower Priority

The most recent IR-4 Workshop for prioritization of research to address grower needs for disease control was held September 21, 2016 in Orlando, FL. Downy mildew control on basil was identified as a grower need for prioritization (vegetable category) and was selected as an "A priority" (highest priority category) for funding.

EFFICACY DATA FOR THE POLYOXIN D ZINC SALT 5SC FORMULATION

During the April 2013 public heading before the NOSB regarding polyoxin D zinc salt, a member of the NOSB commented that the NOSB needed to receive and review efficacy data for polyoxin D zinc salt to confirm that it works. Also, California registrations was *not* considered by the NOSB to be sufficient documentation of efficacy.

A "map" for the location of trial-by-trial efficacy summaries included in the May 31, 2017 petition and this addendum is provided below. Uses are organized by crop group number and then alphabetically by the disease common name. New efficacy trials have focused on berries and small fruits (Crop Group 13).

"Map" of Summarized Efficacy Trials that Included the Polyoxin D Zinc Salt 5SC Formulation						
Disease	Pathogen	Crop Tested and Trial Sequence No. for Crop/Disease	May 31, 2016 Petition		February 2, 2018 Addendum	
			Trial No.	Page No.	Trial No.	Page No.
Crop Group 1: Root and Tuber Vegetables						
Botrytis Vine Rot, Gray Mold, Tan Spot	*Botrytis cinerea*	Potatoes #1	CER-2011-029	148		
Early Blight	*Alternaria solani*	Potatoes #1	CER-2011-029	90		
		Potatoes #2	CER-2011-030	92		
		Potatoes #3	CER-2012-028	94		
Late Blight	*Phytophthora infestans*	Potatoes #1	CER-2012-027	321		
Crop Group 4: Leafy Vegetables (except Brassica Vegetables)						
Downy Mildew	*Bremia lactucae*	Lettuce #1	CER-2011-046	177		
		Lettuce #2	CER-2013-014	179		
		Lettuce #3	CER-2013-032	181		
Gray Mold	*Botrytis cinerea*	Lettuce #1	CER-2011-014	141		
Powdery Mildew	*Golovinomyces cichoracearum*	Lettuce #1	CER-2012-074	267		
White Rust	*Albugo occidentalis*	Spinach #1	CER-2014-063	81		
		Spinach #2			CER-2015-152	64
Crop Group 8: Fruiting Vegetables						
Early Blight	*Alternaria solani* and *A. tomatophila*	Tomatoes #1	CER-2014-095	102		
Late Blight	*Phytophthora infestans*	Tomatoes #1	CER-2011-027	326		
Powdery Mildew	*Leviellula taurica*	Tomatoes #1	CER-2012-016	270		
	Odium neolycopersici	Tomatoes (GH) #1	BCGGA-2015-03	310		
Target Spot	*Corynespora cassiicola*	Tomatoes #1	CER-2014-095	213		
Crop Group 9: Cucurbit Vegetables						
Anthracnose	*Colletotrichum orbiculare*	Cucurbits #1	CER-2014-057	209		
Downy Mildew	*Pseudoperonospora cubensis*	Cucumber #1	CER-2012-067	394		
		Pumpkin #1	CER-2015-145	396		
Gummy Stem Blight	*Didymella bryoniae*	Cantaloupe #1	IND-2012-125	219		
		Cucumber #1	BCGGA-2015-02	221		
		Watermelon #1	CER-2011-028	224		
		Watermelon #2	CER-2012-051	226		
Powdery Mildew	*Podosphaera xanthii*	Cucumber #1	R-14-10-0	381		
		Pumpkin #1	CER-2015-145	383		
		Pumpkin #2	CER-2015-149	385		
Southern Blight	*Sclerotinium rolfsii*	Squash #1	CER-2012-050	400		

"Map" of Summarized Efficacy Trials that Included the Polyoxin D Zinc Salt 5SC Formulation						
Disease	Pathogen	Crop Tested and Trial Sequence No. for Crop/Disease	May 31, 2016 Petition		February 2, 2018 Addendum	
			Trial No.	Page No.	Trial No.	Page No.
Crop Group 11: Pome Fruits						
Fly Speck	*Zygophiala jamaicensis*	Apples #1	CER-2012-025	415		
Powdery Mildew	*Podosphaera leucotricha*	Apples #1	CER-2012-020	362		
		Apples #2	CER-2015-012	364		
		Apples #3	CER-2015-034	366		
		Apples #4			CER-2015-033	66
Sooty Blotch Complex	Geastrumia polystigmatus, *Leptodontium elatus*, and *Peltaster fructicola*	Apples #1	CER-2012-025	258		
Scab	*Venturia inaequalis*	Apples #1	CER-2012-025	409		
Crop Group 12: Stone Fruits						
Brown Rot Blossom Blight	*Monilinia fructicola* and *Monilinia laxa*	Cherries #1	CER-2015-035	283		
		French Prune #1	CER-2013-121	285		
Fruit Brown Rot	*Monilinia fructicola* and *Monilinia laxa*	Nectarine #1 and Peach #1	CER-2013-119	287		
Powdery Mildew	*Podosphaera clandestina*	Cherries #1	CER-2015-032	352		
		Cherries #2			CER-2015-035	68
Crop Group 13: Berries and Small Fruits: Blueberries						
Alternaria Fruit Rot	*Alternaria* spp.	Blueberries #1	CER-2012-049	107		
Botrytis Blight	*Botrytis cinerea*	Blueberries #1	CER-2015-009	116		
Mummyberry	*Monilinia vaccinii-corymbosi*	Blueberries #1	CER-2015-008	299		
		Blueberries #2	CER-2015-143	301		
		Blueberries #3			KAK-2016-Blueberry-MI	70
		Blueberries #4			KAK-2016-Blueberry-WA-Conv	74
		Blueberries #5			KAK-2016-Blueberry-WA-Org	76
		Blueberries #6			KAK-2017-Blueberry-WA-Org	79
Crop Group 13: Berries and Small Fruits: Caneberries						
Botrytis Fruit Rot & Cane Botrytis	*Botrytis cinerea*	Raspberries #1	IND-2015-RASP	155		
		Raspberries #2			IND-2016-Rasp-WA	82
		Raspberries #3			KAK-2017-Rasp-MI	84
Powdery Mildew	*Podosphaera aphanis*	Blackberries #1	CER-2012-060	331		
		Raspberries #1			KAK-2017-Rasp-MI	86
Crop Group 13: Berries and Small Fruits: Cranberries						
Cottonball	*Monilinia oxycocci*	Cranberries #1	IND-2014-165	292		
		Cranberries #2	IND-2015-208	294		
		Cranberries #3			11:SMF011 (2016; WI)	88
Fruit Rot Complex	*Coleophoma empetri*, *Colletotrichum acutatum*, *Colletotrichum gloeosporioides*, *Phyllosticta vaccinii*, and *Physalospora vaccinii*, etc.	Cranberries #1	IND-2014-166	191		
		Cranberries #2	CER-2015-104	193		
		Cranberries #3			11:SMF011 (2016; WI)	90

"Map" of Summarized Efficacy Trials that Included the Polyoxin D Zinc Salt 5SC Formulation						
Disease	Pathogen	Crop Tested and Trial Sequence No. for Crop/Disease	May 31, 2016 Petition		February 2, 2018 Addendum	
			Trial No.	Page No.	Trial No.	Page No.
Crop Group 13: Berries and Small Fruits: Grapes						
Black Rot	*Guignardia bidwellii*	Grapes #1			KAK-2016-Grape-MI	31
		Grapes #2			KAK-2017-Grape-MI	33
		Grapes #3			KAK-2016-Grape-PA	35
		Grapes #4			KAK-2017-Grape-PA	37
Bunch Rot	*Botrytis cinerea*	Grapes #1	CER-2013-002	124		
		Grapes #2	CER-2013-021	126		
		Grapes #3	CER-2014-045	128		
		Grapes #4	CER-2015-115	131		
		Grapes #5	CER-2015-140	134		
		Grapes #6			9:SMF011	94
Downy Mildew	*Plasmopara viticola*	Grapes #1			KAK-2016-Grape-MI	39
		Grapes #2			KAK-2017-Grape-MI	41
Phomopsis Fruit Rot	*Phomopsis viticola*	Grapes #1			KAK-2016-Grape-MI	43
		Grapes #2			KAK-2017-Grape-MI	46
Powdery Mildew	*Erisyphe necator*	Grapes #1	CER-2011-013	241		
		Grapes #2	CER-2012-069	244		
		Grapes #3	CER-2013-021	247		
		Grapes #4	CER-2015-019	249		
		Grapes #5	CER-2015-140	252		
		Grapes #6			KAK-2016-Grape-MI	96
		Grapes #7			KAK-2017-Grape-MI	99
		Grapes #8			KAK-2017-Grape-PA	101
Crop Group 13: Berries and Small Fruits: Strawberries						
Anthracnose Fruit Rot	*Colletotrichum acutatum*	Strawberries #1			KAK-2016-SBerry-MI	48
		Strawberries #2			KAK-2017-SBerry-MI	50
Gray Mold	*Botrytis cinerea*	Strawberries #1	CER-2012-070	166		
		Strawberries #2	CER-2014-038	168		
		Strawberries #3	Review Article, Adaskaveg *et al.*, 2013	170		
		Strawberries #4			KAK-2016-SBerry-MD	104
		Strawberries #5			KAK-2016-SBerry-MI	106
		Strawberries #6			KAK-2017-SBerry-MI	108
Leather Rot	*Phytophthora cactorum*	Strawberries #1			KAK-2016-SBerry-MI	52
		Strawberries #2			KAK-2017-SBerry-MI	54
Phomopsis Leaf Spot	*Phomopsis obscurans*	Strawberries #1			KAK-2016-SBerry-MI	56
		Strawberries #2			KAK-2017-SBerry-MI	59
Powdery Mildew	*Podosphaera aphanis*, *Sphacelotheca* sp.	Strawberries #1	CER-2012-070	342		
		Strawberries #2	CER-2013-008	344		
Crop Group 19: Herbs and Spices						
Downy Mildew	*Peronospora belbahrii*	Basil #1			IND-2015-218	62

NEW EFFICACY DATA FOR NEWLY PETITIONED USES

CROP GROUP 13: BERRIES AND SMALL FRUITS: GRAPES / Black Rot (*Guignardia bidwellii*)

#1: Trial No. KAK-2016-Grape-MI

a. Design

<table>
<tr><th colspan="6">Grapes / Black Rot (Guignardia bidwellii) #1:
Trial No. KAK-2016-Grape-MI: Design</th></tr>
<tr><td>Title:</td><td colspan="5">Evaluation of fungicides for control of foliar and fruit diseases of juice grapes, 2016</td></tr>
<tr><td>Author and affiliation:</td><td colspan="5">A. M. Schilder, J. M. Gillett, and R. W. Sysak
Michigan State University</td></tr>
<tr><td>Publication:</td><td colspan="5">PDMR (planned for fall 2018 publication)</td></tr>
<tr><td>Location:</td><td colspan="5">Fennville, MI</td></tr>
<tr><td>Crop:</td><td colspan="5">Grape (Vitis labrusca “Niagara’)</td></tr>
<tr><td>Disease name:</td><td colspan="5">Black rot</td></tr>
<tr><td>Pathogen:</td><td colspan="5">Guignardia bidwellii</td></tr>
<tr><td>Test plot design:</td><td colspan="5">Randomized complete block</td></tr>
<tr><td>Number of replicates:</td><td colspan="5">4</td></tr>
<tr><td>Application equipment:</td><td colspan="5">Research sprayer with 5-foot spray boom</td></tr>
<tr><td>Spray volume:</td><td colspan="5">50 gal/acre (May 8, 2016 to July 1, 2016)
75 gal/acre (remainder of the season)</td></tr>
<tr><td>Application type(s):</td><td colspan="5">Preventative</td></tr>
<tr><td>Number of applications:</td><td colspan="5">7 (Oso at 10-day to 16-day intervals)</td></tr>
<tr><td rowspan="9">Chronology:</td><td colspan="3">Application</td><td rowspan="2">Growth Stage</td><td rowspan="2">Disease Assessment Date</td></tr>
<tr><td>No.</td><td>Date</td><td>Interval</td></tr>
<tr><td>1</td><td>05/23/2016</td><td></td><td>3-5 inch shoot</td><td>09/09/2016</td></tr>
<tr><td>2</td><td>06/08/2016</td><td>16 days</td><td>10-16 inch shoot</td><td></td></tr>
<tr><td>3</td><td>06/21/2016</td><td>13 days</td><td>Bloom</td><td></td></tr>
<tr><td>4</td><td>07/01/2016</td><td>10 days</td><td>Pea-size fruit</td><td></td></tr>
<tr><td>5</td><td>07/12/2016</td><td>11 days</td><td>2nd post-bloom</td><td></td></tr>
<tr><td>6</td><td>07/27/2016</td><td>15 days</td><td>3rd post bloom</td><td></td></tr>
<tr><td>7</td><td>08/03/2016 A</td><td>7 days</td><td></td><td></td></tr>
<tr><td>8</td><td>08/10/2016</td><td>7 days</td><td>4th post-bloom</td><td></td></tr>
<tr><td>Disease assessment methodology:</td><td colspan="5">• 25 randomly selected leaves and clusters from the center vine in each plot were visually rated.
• Incidence = Percent leaves or clusters with disease.
• Severity = Percent area symptomatic on diseased plants only.
• Overall Severity = (Incidence x Severity) / 100.</td></tr>
<tr><td colspan="6">A. 08/03/2016 application was limited to selected treatment programs that included Ridomil Gold SL to control downy mildew.</td></tr>
</table>

b. Results

Grapes / Black Rot (*Guignardia bidwellii*) #1: Trial No. KAK-2016-Grape-MI: Results (9/10/2016)									
Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	App. Code	Incidence (%)	Severity (%)	Overall Severity (%)	Percent Control
Untreated control			Not Applicable			82.0 a	45.4 a	37.44 a	
Oso 5%SC	6.5 fl oz	25	Polyoxin D zinc salt	19	1,2,3,4, 5,6,8	46.0 b	10.3 b	4.66 b	87
Oso 5%SC	13 fl oz	50	Polyoxin D zinc salt	19	1,2,3,4, 5,6,8	17.0 def	3.4 cd	0.64 c	98
Ranman	2.75 fl oz		Cyazofamid	21	1,2,3,4, 5,6,8	24.0 cd	2.2 de	0.63 c	98
Silwet L-77	2 fl oz		Nonionic surfactant	NA					
Manzate Pro-Stick	3 lb		Cymoxanil	27	1, 2	0.0 g	0.0 g	0.0 c	100
Pristine 38WG	12.5 oz		Boscalid	7	3,4,6,8				
			Pyraclostrobin	11					
Super Spread 90	0.125%		Non-ionic surfactant	NA					
Ziram 76DF	3 lb		Ziram	M3	5				
Ridomil Gold			Mefenoxam	4	7				
Treatment means followed by the same letter are not statistically different according to the Fischer's Protected SD test at $P \leq 0.05$.									

The first assessments were performed after the last treatment. Therefore, all treatments are assumed to be preventative.

The researchers reported the black rot disease pressure to be light on leaves and moderate on fruit.

No phytotoxicity was observed.

c. Discussion

In this trial, Oso applied at 6.5 fl oz/acre and 13 fl oz/acre provided 87% and 98% control, respectively, of black rot on grape clusters.

No OMRI-listed products were evaluated in this trial.

#2: Trial No. KAK-2017-Grape-MI

a. Design

Grapes / Black Rot (*Guignardia bidwellii*) #2: Trial No. KAK-2017-Grape-MI: Design					
Title:	Evaluation of fungicides for control of foliar diseases of juice grapes, 2017				
Author and affiliation:	A. M.C. Schilder, J. M. Gillett, and R. W. Sysak Michigan State University				
Publication:	PDMR (planned for fall 2018 publication)				
Location:	Fennville, MI				
Crop:	Grape ('Niagara')				
Disease name:	Black rot				
Pathogen:	*Guidnardia bidwellii*				
Test plot design:	Randomized complete block				
Number of replicates:	4				
Application equipment:	Research sprayer with 5-foot boom				
Spray volume:	40 gallons/acre (first 3 applications) 50 gallons/acre (later season applications)				
Application type(s):	Preventative				
Number of applications:	7				
Chronology:	App. Code	Application Dates	App. Interval (Days)	Growth Stage	Disease Assessment Dates
	A	05/16/2017		3-5 inch shoots	08/23/2017
	B	05/30/2017	14	7-17 inch shoots	
	C	06/10/2017	11	Pre-bloom/bloom	
	D	06/21/2017	11	1st post-bloom; bb-size fruit	
	E	07/11/2017	19	2nd post-bloom; pea-size fruit	
	F	07/25/2017	14	3rd post-bloom; pre-bunch closure	
	G	08/14/2017	20	4th post-bloom; bunch closure	
Disease assessment methodology:	Incidence: % of leaves or clusters with disease. Severity: % area symptomatic on diseased plant parts only. Overall severity: (Incidence x Severity) / 100.				

b. Results

Grapes / Black Rot (*Guignardia bidwellii*) #2: Trial No. KAK-2017-Grape-MI: Results: Leaves									
Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	App Code	Incidence (%)	Severity (%)	Overall Severity (%)	Control (%)
Untreated control			Not Applicable			62.0 a	13.2 a	8.2 a	
Oso	13.0 fl oz	50	Polyoxin D zinc salt	19	ABCDEFG	26.0 c	3.9 c	1.1 c	87
Lifegard WG	4.5 oz/ 100 gal		*Bacillus mycoides* isolate J		ABCDEFG	40.0 b	6.5 b	2.6 b	68
Stargus	64 fl oz		*Bacillus amyloliquefaciencs* strain F727		ABCDEFG	35.0 b	6.5 b	2.3 b	72
Intuity 4SC	6 fl oz		Mandestrobin	11	ABCDEFG	40.0 b	5.6 b	2.3 b	72
Super Spread 90	0.125% (v/v)		Non-ionic surfactant	NA	ABCDEFG				
Treatment means followed by the same letter are not statistically different according to the Fischer's Protected LSD test at P ≤ 0.05.									

Grapes / Black Rot (*Guignardia bidwellii*) #2: Trial No. KAK-2017-Grape-MI: Results: Clusters									
Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	App Code	Incidence (%)	Severity (%)	Overall Severity (%)	Control (%)
Untreated control			Not Applicable			66.0 a	36.9 a	36.9 a	
Oso	13.0 fl oz	50	Polyoxin D zinc salt	19	ABCDEFG	29.0 ef	5.2 bc	5.2 bcd	86
Lifegard WG	4.5 oz/ 100 gal		*Bacillus mycoides* isolate J	44	ABCDEFG	43.0 b	7.9 b	7.9 b	79
Stargus	64 fl oz		*Bacillus amyloliquefaciencs* strain F727	44	ABCDEFG	42.0 bc	6.0 bc	6.0 bc	84
Intuity 4SC	6 fl oz		Mandestrobin	11	ABCDEFG	41.0 bcd	7.4 b	7.4 b	80
Super Spread 90	0.125% (v/v)		Non-ionic surfactant	NA	ABCDEFG				
Treatment means followed by the same letter are not statistically different according to the Fischer's Protected LSD test at P ≤ 0.05.									

The researchers described the black rot disease pressure:

- On grape leaves as light; and
- On grape clusters as moderate.

No phytotoxicity was observed.

c. Discussion

In this trial, Oso applied at 13 fl oz/acre provided 87% and 86% control of black rot on grape leaves and clusters, respectively.

OMRI-listed products evaluated in this trial included Lifegard WG and Stargus. Oso applied at 13 fl oz/acre provided control of black rot on grapes that is numerically *superior* to that of Lifegard WG and Stargus.

#3: Trial No. KAK-2016-Grape-PA

a. Design

<table>
<tr><th colspan="7">Grapes / Black Rot (Guidnardia bidwellii) #3:
Trial No. KAK-2016-Grape-PA: Design</th></tr>
<tr><td>Title:</td><td colspan="6">Evaluation of OSO 5% and other alternative fungicides on Vitis labrusca ‘Concord’ grapes, 2016.</td></tr>
<tr><td>Author and affiliation:</td><td colspan="6">Bryan Hed
Lake Erie Regional Grape Research and Extension Center
Penn State University</td></tr>
<tr><td>Publication:</td><td colspan="6">PDMR 11:SMF009</td></tr>
<tr><td>Location:</td><td colspan="6">North East, PA</td></tr>
<tr><td>Crop:</td><td colspan="6">Grapes (Concord)</td></tr>
<tr><td>Disease name:</td><td colspan="6">Black rot</td></tr>
<tr><td>Pathogen:</td><td colspan="6">Guidnardia bidwellii</td></tr>
<tr><td>Test plot design:</td><td colspan="6">Randomized complete block</td></tr>
<tr><td>Number of replicates:</td><td colspan="6">4</td></tr>
<tr><td>Application equipment:</td><td colspan="6">Friend covered-boom plot sprayer</td></tr>
<tr><td>Spray volume:</td><td colspan="6">50 gallons/acre (100 psi)</td></tr>
<tr><td>Application type(s):</td><td colspan="6">Preventative assumed.
Mummies were placed in the trellis as a source of inoculum.</td></tr>
<tr><td>Number of applications:</td><td colspan="6">6 (Oso; no application C2 at 21 days after the first application.)</td></tr>
<tr><td rowspan="10">Chronology:</td><td colspan="3">Application</td><td rowspan="2">Days After First Application</td><td rowspan="2">Growth Stage</td><td rowspan="2">Disease Assessment Dates</td></tr>
<tr><td>Code</td><td>Dates</td><td>Interval (Days)</td></tr>
<tr><td>A</td><td>05/23/2016</td><td></td><td>0</td><td>3-6 inch shoots</td><td>08/08/2016</td></tr>
<tr><td>B</td><td>06/02/2016</td><td>9</td><td>9</td><td>10-12 inch shoots</td><td>08/30/2016</td></tr>
<tr><td>C_1</td><td>06/11/2016</td><td>9</td><td>18</td><td>Immediate pre-bloom</td><td></td></tr>
<tr><td>C_2*</td><td>06/14/2016</td><td>12*</td><td>21</td><td>Bloom
(not used for Oso)</td><td></td></tr>
<tr><td>D</td><td>06/21/2016</td><td>10**</td><td>28</td><td>1st post-bloom</td><td></td></tr>
<tr><td>E</td><td>06/30/2016</td><td>9</td><td>37</td><td>2nd post-bloom</td><td></td></tr>
<tr><td>F</td><td>07/12/2016</td><td>12</td><td>49</td><td>Pea-size berries</td><td></td></tr>
<tr><td colspan="6">* Included exclusively in the treatment program that began with Manzate. Not used for Oso and the other treatments.
** Application interval for Oso and other treatments excluding the Manzate treatment program.</td></tr>
<tr><td>Disease assessment methodology:</td><td colspan="6">Severity was rated using the Barratt-Horsfall scale and was converted to % area infected (0-100%) using Elanco conversion tables.
Incidence = Percent clusters diseased.
Severity = Percent area of clusters diseased.</td></tr>
</table>

b. Results

This trial was conducted during a local drought. Total rainfall for May, June, July, and September was 2.1, 1.9, 2.7, 4.5 and 5.2 inches, respectively. Dry weather during May, June, and July made for very unfavorable conditions for fungal infections and resulted in low levels of disease.

For clusters with no mummies in the trellis to serves as inoculum, the disease pressure was too low (2.0% incidence and 0.05% severity) for meaningful data. Statistical differences in incidence and severity were observed for clusters for which black rot mummies were included in the trellis.

Grapes / Black Rot (*Guidnardia bidwellii*) #3: Trial No. KAK-2016-Grape-PA: Results: Clusters									
Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	App Code	With Mummies in the Trellis to Serve as Inoculum			
						Incidence		Severity	
						Measured (%)	% Control	Measured (%)	% Control
Untreated control			Not Applicable			55.0 ab		7.02 b	
OSO 5%	13.0 fl oz	50	Polyoxin D zinc salt	19	ABC_1DEFG	53.6 ab	2.5	7.26 b	-3.4
Fracture	36.6 fl oz		Banda de Lupinus albus doce (BLAD)	BM1	ABC_1DEFG	51.3 b	6.7	9.02 ab	-28.5
Double Nickel	3 qt		*Bacillus amyloliquefaciens* str. D747	44	ABC_1DEFG	76.7 a	-39.5	12.98 a	-84.9
Badge X2	1.75 lb		Copper hydroxide, Copper oxychloride	M1	ABC_1DEFG	15.0 c	72.7	1.29 c	81.6
Lime	1.75 lb		Calcium hydroxide	NA	ABC_1DEFG				
Conventional standard:									
• Manzate Prostik	3 lb		Cymoxanil	27	AB	0.8 c	98.5	0.02 c	99.7
• Ziram	4 lb		Zinc dimethyldithio-carbamate	M3	C_2DEF				
• Quintec	4 fl oz		Quinoxyfen	13	C_2 E				
• Vivando	10.3 fl oz		Metrafenone	U8	D				
• Toledo	4 oz		Tebuconazole	3	G				
Treatment means followed by the same letter are not statistically different according to Fisher's LDS test at $P \leq 0.05$.									

No phytotoxicity was observed.

c. Discussion

In this trial, Oso applied at 13 fl oz/acre provided very modest control of black rot incidence (2.5%) in grape clusters when cages with black rot mummies were attached to the trellis to serve as inoculum. In the absence of the mummies, no significant black rot was observed.

OMRI-listed products evaluated in this trial included Double Nickel and a tank-mixture of Badge X2 and lime. Based upon this trial, Oso provided:

- *Superior* performance compared to Double Nickel; and
- *Inferior* performance compared to Badge X2 tank-mixed with lime.

Fracture is a biopesticide. However, based upon the label posted to the Internet, Fracture is *not* OMRI-listed.

#4: Trial No. KAK-2017-Grape-PA

a. Design

<table>
<tr><th colspan="7">Grapes / Black Rot (Guidnardia bidwellii) #4:
Trial No. KAK-2017-Grape-PA: Design</th></tr>
<tr><td>Title:</td><td colspan="6">Evaluation of OSO 5% and other alternative fungicides on Vitis labrusca ‘Concord’ grapes, 2017.</td></tr>
<tr><td>Author and affiliation:</td><td colspan="6">Bryan Hed
Lake Erie Regional Grape Research and Extension Center
Penn State University</td></tr>
<tr><td>Publication:</td><td colspan="6">PDMR (submitted)</td></tr>
<tr><td>Location:</td><td colspan="6">North East, PA</td></tr>
<tr><td>Crop:</td><td colspan="6">Grapes (Concord)</td></tr>
<tr><td>Disease name:</td><td colspan="6">Black rot</td></tr>
<tr><td>Pathogen:</td><td colspan="6">Guidnardia bidwellii</td></tr>
<tr><td>Test plot design:</td><td colspan="6">Randomized complete block</td></tr>
<tr><td>Number of replicates:</td><td colspan="6">4</td></tr>
<tr><td>Application equipment:</td><td colspan="6">Friend covered-boom plot sprayer</td></tr>
<tr><td>Spray volume:</td><td colspan="6">50 gallons/acre (100 psi)</td></tr>
<tr><td>Application type(s):</td><td colspan="6">Preventative assumed.
Mummies were placed in the trellis as a source of inoculum.</td></tr>
<tr><td>Number of applications:</td><td colspan="6">7</td></tr>
<tr><td rowspan="9">Chronology:</td><td colspan="3">Application</td><td rowspan="2">Days After First Application</td><td rowspan="2">Growth Stage</td><td rowspan="2">Disease Assessment Dates</td></tr>
<tr><td>Code</td><td>Dates</td><td>Interval (Days)</td></tr>
<tr><td>A</td><td>05/10/2017</td><td></td><td>0</td><td>3-6 inch shoots</td><td>08/04/2017</td></tr>
<tr><td>B</td><td>05/19/2017</td><td>9</td><td>9</td><td>10-12 inch shoots</td><td>08/30/2017</td></tr>
<tr><td>C</td><td>05/28/2017</td><td>9</td><td>18</td><td>12-16 inch shoots</td><td></td></tr>
<tr><td>D</td><td>06/08/2017</td><td>11</td><td>29</td><td>Immediate pre-bloom</td><td></td></tr>
<tr><td>E</td><td>06/18/2017</td><td>10</td><td>39</td><td>1st post-bloom</td><td></td></tr>
<tr><td>F</td><td>06/28/2017</td><td>10</td><td>49</td><td>2nd post-bloom</td><td></td></tr>
<tr><td>G</td><td>07/09/2017</td><td>11</td><td>60</td><td>3rd post-bloom</td><td></td></tr>
<tr><td>Disease assessment methodology:</td><td colspan="6">Severity was rated using the Barratt-Horsfall scale and was converted to percent area infected (0-100%) using Elanco conversion tables.</td></tr>
</table>

For both the 2016 and 2017 trials conducted in North East, PA first applications were made when the grapes were at 3-6 inch shoot stage. The 2017 trial included one more application than the 2016 trial at the same location. The 2017 trial included an application at 12-16 inch shoot length that was not included in the 2016 trial. The 2017 trial included an application at 60 days after the last treatment, whereas the last application in the 2016 trial was made 49 days after the first application.

b. Results

This trial was conducted during the second year of a local drought. Total rainfall for May, June, July, August, and September was 5.70, 3.62, 0.84, 2.35, and 2.7 inches, respectively. Dry weather conditions greatly limited black rot development, particularly during July.

For clusters with no mummies in the trellis to serves as inoculum, the disease pressure was too low for meaningful data. Statistical differences in incidence and severity were observed for clusters for which black rot mummies were included in the trellis.

Grapes / Black Rot (*Guidnardia bidwellii*) #4:
Trial No. KAK-2017-Grape-PA: Results: Clusters

Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	App Code	With Mummies in the Trellis to Serve as Inoculum			
						Incidence (%)		Severity (%)	
						Measured	% Control	Measured	% Control
Untreated control			Not Applicable			85.8 a		20.66 a	
OSO 5%	13.0 fl oz	50	Polyoxin D zinc salt	19	ABCDEFG	59.2 ab	31.0	12.16 ab	41.1
Fracture	36.6 fl oz		Banda de Lupinus albus doce (BLAD)	BM1	ABCDEFG	85.0 ab	1.2	20.13 a	2.6
Double Nickel	3 qt		*Bacillus amyloliquefaciens* str. D747	44	ABCDEFG	85.0 ab	1.2	22.44 a	-8.6
Badge X2	1.75 lb		Copper hydroxide, Copper oxychloride	M1	ABCDEFG	44.2 b	48.5	5.47 b	73.5
Lime	1.75 lb		Calcium hydroxide	NA	ABCDEFG				
Conventional standard:									
• Manzate Prostik	3 lb		Cymoxanil	27	ABCD	0.8 c	99.1	0.02 b	99.9
• Ziram	4 lb		Zinc dimethyldithio-carbamate	M3	EFG				
• Quintec	4 fl oz		Quinoxyfen	13	D G				
• Vivando	10.3 fl oz		Metrafenone	U8	E				
• Toledo	4 oz		Tebuconazole	3	F				

Treatment means followed by the same letter are not statistically different according to Fisher's LDS test at $P \leq 0.05$.

No phytotoxicity was observed.

c. Discussion

In this trial, Oso applied at 13 fl oz/acre provided 41.1% control of black rot on grape clusters when cages with black rot mummies were attached to the trellis to serve as inoculum. In the absence of the mummies, no significant black rot was observed.

OMRI-listed products evaluated in this trial included Double Nickel and a tank-mixture of Badge X2 and lime.

Fracture is a biopesticide. However, based upon the label posted to the Internet, Fracture is *not* OMRI-listed.

Based upon this trial, Oso applied at 13 fl oz/acre provided control of black rot on grapes that was:

- *Superior* to that of Double Nickel; and
- *Statistically equivalent* to that of Badge X2 tank-mixed with lime.

CROP GROUP 13: GRAPES / Downy mildew (*Plasmopara viticola*)

#1: Trial No. KAK-2016-Grape-MI

a. Design

Grapes / Downy Mildew (*Plasmopara viticola*) #1: Trial No. KAK-2016-Grape-MI: Design					
Title:	Evaluation of fungicides for control of foliar and fruit diseases of juice grapes, 2016				
Author and affiliation:	A. M. Schilder, J. M. Gillett, and R. W. Sysak Michigan State University				
Publication:	PDMR (planned for fall 2018 publication)				
Location:	Fennville, MI				
Crop:	Grape (Vitis labrusca "Niagara')				
Disease name:	Downy mildew				
Pathogen:	*Plasmopara viticola*				
Test plot design:	Randomized complete block				
Number of replicates:	4				
Application equipment:	Research sprayer with 5-foot spray boom				
Spray volume:	50 gal/acre (May 8, 2016 to July 1, 2016) 75 gal/acre (remainder of the season)				
Application type(s):	Preventative				
Number of applications:	7 (Oso at 10-day to 16-day intervals)				
Chronology:	Application			Growth Stage	Disease Assessment Date
	No.	Date	Interval		
	1	05/23/2016		3-5 inch shoot	09/12/2016
	2	06/08/2016	16 days	10-16 inch shoot	
	3	06/21/2016	13 days	Bloom	
	4	07/01/2016	10 days	Pea-size fruit	
	5	07/12/2016	11 days	2nd post-bloom	
	6	07/27/2016	15 days	3rd post bloom	
	7	08/03/2016 [A]	7 days		
	8	08/10/2016	7 days	4th post-bloom	
Disease assessment methodology:	• 25 randomly selected leaves and clusters from the center vine in each plot were visually rated. • Incidence = Percent leaves or clusters with disease. • Severity = Percent area symptomatic on diseased plants only. • Overall Severity = (Incidence x Severity) / 100.				
A. 08/03/2016 application was limited to selected treatment programs that included Ridomil Gold SL to control downy mildew.					

b. Results

Grapes / Downy Mildew (*Plasmopara viticola*) #1: Trial No. KAK-2016-Grape-MI: Results (9/12/2016)									
Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	App. Code	Incidence on Leaves (%)	Severity on Leaves (%)	Overall Severity on Leaves (%)	Percent Control on Leaves
Untreated control			Not Applicable			83.0 a	44.3 a	36.68 a	
Oso 5%SC	6.5 fl oz	25	Polyoxin D zinc salt	19	1,2,3,4, 5,6,8	39.0 bc	7.6 b	2.89 b	92
Oso 5%SC	13 fl oz	50	Polyoxin D zinc salt	19	1,2,3,4, 5,6,8	6.0 e	1.3 d	0.10 d	99
Ranman	2.75 fl oz		Cyazofamid	21	1,2,3,4, 5,6,8	3.0 ef	1.0 de	0.06 d	99
Silwet L-77	2 fl oz		Nonionic surfactant	NA					
Manzate Pro-Stick	3 lb		Cymoxanil	27	1, 2	0.0 f	0.0 f	0.0 d	100
Pristine 38WG	12.5 oz		Boscalid	7	3,4,6,8				
			Pyraclostrobin	11					
Super Spread 90	0.125%		Non-ionic surfactant	NA					
Ziram 76DF	3 lb		Ziram	M3	5				
Ridomil Gold			Mefenoxam	4	7,8				
Treatment means followed by the same letter are not statistically different according to the Fischer's Protected SD test at $P \leq 0.05$.									

The first assessments were performed after the last treatment. Therefore, all treatments are assumed to be preventative.

The researchers reported the downy mildew disease pressure to be moderately high.

No phytotoxicity was observed.

c. Discussion

In this trial, Oso applied at 6.5 fl oz/acre and 13 fl oz/acre provided 92% and 99% control, respectively, of downy mildew on grape leaves.

No OMRI-listed products were evaluated in this trial.

#2: Trial No. KAK-2017-Grape-MI

a. Design

Grapes / Downy Mildew (*Plasmopara viticola*) #2: Trial No. KAK-2017-Grape-MI: Design					
Title:	Evaluation of fungicides for control of foliar diseases of juice grapes, 2017				
Author and affiliation:	A. M.C. Schilder, J. M. Gillett, and R. W. Sysak Michigan State University				
Publication:	PDMR (planned for fall 2018 publication)				
Location:	Fennville, MI				
Crop:	Grape ('Niagara')				
Disease name:	Downy mildew				
Pathogen:	*Plasmopara vitacola*				
Test plot design:	Randomized complete block				
Number of replicates:	4				
Application equipment:	Research sprayer with 5-foot boom				
Spray volume:	40 gallons/acre (first 3 applications) 50 gallons/acre (later season applications)				
Application type(s):	Preventative				
Number of applications:	7				
Chronology:	App. Code	Application Dates	App. Interval (Days)	Growth Stage	Disease Assessment Dates
	A	05/16/2017		3-5 inch shoots	09/21/2017
	B	05/30/2017	14	7-17 inch shoots	
	C	06/10/2017	11	Pre-bloom/bloom	
	D	06/21/2017	11	1st post-bloom; bb-size fruit	
	E	07/11/2017	19	2nd post-bloom; pea-size fruit	
	F	07/25/2017	14	3rd post-bloom; pre-bunch closure	
	G	08/14/2017	20	4th post-bloom; bunch closure	
Disease assessment methodology:	Incidence: % of leaves or clusters with disease. Severity: % area symptomatic on diseased plant parts only. Overall severity: (Incidence x Severity) / 100.				

b. Results

Grapes / Downy Mildew (*Plasmopara viticola*) #2: Trial No. KAK-2017-Grape-MI: Results: Clusters									
Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	App Code	Incidence (%)	Severity (%)	Overall Severity (%)	Control (%)
Untreated control			Not Applicable			78.0 a	55.5 a	43.1 a	
Oso	13.0 fl oz	50	Polyoxin D zinc salt	19	ABCDEFG	36.0 c	5.7 bc	2.1 cd	95
Lifegard WG	4.5 oz/ 100 gal		*Bacillus mycoides* isolate J	44	ABCDEFG	42.0 b	6.9 b	2.9 b	93
Stargus	64 fl oz		*Bacillus amyloliquefaciencs* strain F727	44	ABCDEFG	38.0 bc	6.4 b	2.5 bc	94
Intuity 4SC	6 fl oz		Mandestrobin	11	ABCDEFG	38.0 bc	6.0 b	2.3 bc	94
Super Spread 90	0.125% (v/v)		Non-ionic surfactant	NA	ABCDEFG				
Treatment means followed by the same letter are not statistically different according to the Fischer's Protected LSD test at P ≤ 0.05.									

The researchers described the downy mildew disease pressure as moderately high.

No phytotoxicity was observed.

c. Discussion

In this trial, Oso applied at 13 fl oz/acre provided 95% control of downy mildew on grape clusters.

OMRI-listed products evaluated in this trial included Lifegard and Stargus. Oso applied at 13.0 fl oz/acre provided control of downy mildew on grape clusters that was numerically *superior* to that provided by Lifegard WG and Stargus.

CROP GROUP 13: GRAPES / Phomopsis Fruit Rot (*Phomopsis viticola*)

#1: Trial No. KAK-2016-Grape-MI

a. Design

<table>
<tr><th colspan="6">Grapes / Phomopsis Fruit Rot (Phomopsis viticola) #1:
Trial No. KAK-2016-Grape-MI: Design</th></tr>
<tr><td>Title:</td><td colspan="5">Evaluation of fungicides for control of foliar and fruit diseases of juice grapes, 2016</td></tr>
<tr><td>Author and affiliation:</td><td colspan="5">A. M. Schilder, J. M. Gillett, and R. W. Sysak
Michigan State University</td></tr>
<tr><td>Publication:</td><td colspan="5">PDMR (planned for fall 2018 publication)</td></tr>
<tr><td>Location:</td><td colspan="5">Fennville, MI</td></tr>
<tr><td>Crop:</td><td colspan="5">Grape (Vitis labrusca “Niagara’)</td></tr>
<tr><td>Disease name:</td><td colspan="5">Phomopsis fruit rot</td></tr>
<tr><td>Pathogen:</td><td colspan="5">Phomopsis viticola</td></tr>
<tr><td>Test plot design:</td><td colspan="5">Randomized complete block</td></tr>
<tr><td>Number of replicates:</td><td colspan="5">4</td></tr>
<tr><td>Application equipment:</td><td colspan="5">Research sprayer with 5-foot spray boom</td></tr>
<tr><td>Spray volume:</td><td colspan="5">50 gal/acre (May 8, 2016 to July 1, 2016)
75 gal/acre (remainder of the season)</td></tr>
<tr><td>Application type(s):</td><td colspan="5">Preventative</td></tr>
<tr><td>Number of applications:</td><td colspan="5">7 (Oso at 10-day to 16-day intervals)</td></tr>
<tr><td rowspan="9">Chronology:</td><td colspan="3">Application</td><td rowspan="2">Growth Stage</td><td rowspan="2">Disease Assessment Date</td></tr>
<tr><td>No.</td><td>Date</td><td>Interval</td></tr>
<tr><td>1</td><td>05/23/2016</td><td></td><td>3-5 inch shoot</td><td>09/15/2016</td></tr>
<tr><td>2</td><td>06/08/2016</td><td>16 days</td><td>10-16 inch shoot</td><td></td></tr>
<tr><td>3</td><td>06/21/2016</td><td>13 days</td><td>Bloom</td><td></td></tr>
<tr><td>4</td><td>07/01/2016</td><td>10 days</td><td>Pea-size fruit</td><td></td></tr>
<tr><td>5</td><td>07/12/2016</td><td>11 days</td><td>2nd post-bloom</td><td></td></tr>
<tr><td>6</td><td>07/27/2016</td><td>15 days</td><td>3rd post bloom</td><td></td></tr>
<tr><td>7</td><td>08/03/2016 [A]</td><td>7 days</td><td></td><td></td></tr>
<tr><td>8</td><td>08/10/2016</td><td>7 days</td><td>4th post-bloom</td><td></td></tr>
<tr><td>Disease assessment methodology:</td><td colspan="5">• 25 randomly selected leaves and clusters from the center vine in each plot were visually rated.
• Incidence = Percent leaves or clusters with disease.
• Severity = Percent area symptomatic on diseased plants only.
• Overall Severity = (Incidence x Severity) / 100.</td></tr>
<tr><td colspan="6">A. 08/03/2016 application was limited to selected treatment programs that included Ridomil Gold SL to control downy mildew.</td></tr>
</table>

b. Results

Grapes / Phomopsis Fruit Rot (*Phomopsis viticola*) #1: Trial No. KAK-2016-Grape-MI: Results: Rachis (9/15/2016)									
Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	App. Code	Incidence (%)	Severity (%)	Overall Severity (%)	Percent Control
Untreated control			Not Applicable			57.0 a	22.4 a	12.64 a	
Oso 5%SC	6.5 fl oz	25	Polyoxin D zinc salt	19	1,2,3,4, 5,6,8	39.0 b	10.4 b	3.98 b	68
Oso 5%SC	13 fl oz	50	Polyoxin D zinc salt	19	1,2,3,4, 5,6,8	14.0 fg	3.6 d	0.55 de	96
Ranman	2.75 fl oz		Cyazofamid	21	1,2,3,4, 5,6,8	20.0 ef	3.5 d	0.71 d	94
Silwet L-77	2 fl oz		Nonionic surfactant	NA					
Manzate Pro-Stick	3 lb		Cymoxanil	27	1, 2	2.0 l	1.0 ef	0.04 g	99
Pristine 38WG	12.5 oz		Boscalid	7	3,4,6,8				
			Pyraclostrobin	11					
Super Spread 90	0.125%		Non-ionic surfactant	NA					
Ziram 76DF	3 lb		Ziram	M3	5				
Ridomil Gold			Mefenoxam	4	7				
Treatment means followed by the same letter are not statistically different according to the Fischer's Protected SD test at $P \leq 0.05$.									

The first assessments were performed after the last treatment. Therefore, all treatments are assumed to be preventative.

The researchers reported the Phomopsis disease pressure to be low to moderate.

No phytotoxicity was observed.

c. Comparison to OMRI-Listed Products

In this trial, Oso applied at 6.5 fl oz/acre and 13 fl oz/acre provided 68% and 96% control, respectively, of Phomopsis fruit rot on grape rachis (main axis of the cluster).

No OMRI-listed products were evaluated in this trial.

Grapes / Phomopsis Fruit Rot (*Phomopsis viticola*) #1:
Trial No. KAK-2016-Grape-MI: Results: Fruit (9/15/2016)

Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	App. Code	Incidence (%)	Severity (%)	Overall Severity (%)	Percent Control
Untreated control			Not Applicable			57.0 a	41.7 a	23.62 a	
Oso 5%SC	6.5 fl oz	25	Polyoxin D zinc salt	19	1,2,3,4, 5,6,8	39.0 b	20.3 b	7.68 b	67
Oso 5%SC	13 fl oz	50	Polyoxin D zinc salt	19	1,2,3,4, 5,6,8	14.0 fg	7.0 d	1.06 de	96
Ranman	2.75 fl oz		Cyazofamid	21	1,2,3,4, 5,6,8	20.0 ef	7.1 d	1.42 d	94
Silwet L-77	2 fl oz		Nonionic surfactant	NA					
Manzate Pro-Stick	3 lb		Cymoxanil	27	1, 2	2.0 l	1.3 ef	0.05 e	99
Pristine 38WG	12.5 oz		Boscalid	7	3,4,6,8				
			Pyraclostrobin	11					
Super Spread 90	0.125%		Non-ionic surfactant	NA					
Ziram 76DF	3 lb		Ziram	M3	5				
Ridomil Gold			Mefenoxam	4	7				

Treatment means followed by the same letter are not statistically different according to the Fischer's Protected SD test at $P \leq 0.05$.

The first assessments were performed after the last treatment. Therefore, all treatments are assumed to be preventative.

No phytotoxicity was observed.

c. Discussion

In this trial, Oso applied at 6.5 fl oz/acre and 13 fl oz/acre provided 67% and 96% control, respectively, of Phomopsis fruit rot on grapes.

No OMRI-listed products were evaluated in this trial.

#2: Trial No. KAK-2017-Grape-MI

a. Design

Grapes / Phomopsis Fruit Rot (*Phomopsis viticola*) #2: Trial No. KAK-2017-Grape-MI: Design					
Title:	Evaluation of fungicides for control of foliar diseases of juice grapes, 2017				
Author and affiliation:	A. M.C. Schilder, J. M. Gillett, and R. W. Sysak Michigan State University				
Publication:	PDMR (planned for fall 2018 publication)				
Location:	Fennville, MI				
Crop:	Grape ('Niagara')				
Disease name:	Phomopsis fruit rot				
Pathogen:	*Phomopsis vitaola*				
Test plot design:	Randomized complete block				
Number of replicates:	4				
Application equipment:	Research sprayer with 5-foot boom				
Spray volume:	40 gallons/acre (first 3 applications) 50 gallons/acre (later season applications)				
Application type(s):	Preventative				
Number of applications:	7				
Chronology:	App. Code	Application Dates	App. Interval (Days)	Growth Stage	Disease Assessment Dates
	A	05/16/2017		3-5 inch shoots	09/25/2017
	B	05/30/2017	14	7-17 inch shoots	
	C	06/10/2017	11	Pre-bloom/bloom	
	D	06/21/2017	11	1st post-bloom; bb-size fruit	
	E	07/11/2017	19	2nd post-bloom; pea-size fruit	
	F	07/25/2017	14	3rd post-bloom; pre-bunch closure	
	G	08/14/2017	20	4th post-bloom; bunch closure	
Disease assessment methodology:	Incidence: % of leaves or clusters with disease. Severity: % area symptomatic on diseased plant parts only. Overall severity: (Incidence x Severity) / 100.				

b. Results

Grapes / Phomopsis Fruit Rot (*Phomopsis viticola*) #2: Trial No. KAK-2017-Grape-MI: Results: Clusters									
Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	App Code	Incidence (%)	Severity (%)	Overall Severity (%)	Control (%)
Untreated control			Not Applicable			88.0 a	51.8 a	45.5 a	
Oso	13.0 fl oz	50	Polyoxin D zinc salt	19	ABCDEFG	28.0 cd	4.8 d	1.4 c	97
Lifegard WG	4.5 oz/ 100 gal		*Bacillus mycoides* isolate J	44	ABCDEFG	44.0 b	12.7 b	5.6 b	88
Stargus	64 fl oz		*Bacillus amyloliquefaciencs* strain F727	44	ABCDEFG	34.0 c	11.5 b	3.8 b	92
Intuity 4SC	6 fl oz		Mandestrobin	11	ABCDEFG	8.0 e	1.8 de	0.3 d	99
Super Spread 90	0.125% (v/v)		Non-ionic surfactant	NA	ABCDEFG				
Treatment means followed by the same letter are not statistically different according to the Fischer's Protected LSD test at P ≤ 0.05.									

The researchers described the Phomopsis fruit rot disease pressure as moderate.

No phytotoxicity was observed.

c. Discussion

In this trial, Oso applied at 13 fl oz/acre provided 97% control of Phomopsis fruit rot on grape clusters.

OMRI-listed products evaluated in this trial included Lifegard and Stargus. Oso applied at 13.0 fl oz/acre provided control of Phomopsis fruit rot on grapes that was statistically *superior* to that provided by Lifegard WG and Stargus.

CROP GROUP 13: STRAWBERRIES / Anthracnose Fruit Rot (*Colletotrichum acutatum*)

#1: Trial No. KAK-2016-SBerry-MI

a. Design

<table>
<tr><th colspan="7">Strawberries /Anthracnose Fruit Rot (Colletotrichum acutatum) #1:
Trial No. KAK-2016-Sberry-MI: Design</th></tr>
<tr><td>Title:</td><td colspan="6">Evaluations of fungicides for control of leaf and fruit rot diseases in matted-row strawberry, 2016</td></tr>
<tr><td>Author and affiliation:</td><td colspan="6">A. M. C. Schilder, N. M. Gillett, and R. W. Sysak
Michigan State University</td></tr>
<tr><td>Publication:</td><td colspan="6">PDMR (planned for fall 2018 publication)</td></tr>
<tr><td>Location:</td><td colspan="6">Camden, MI</td></tr>
<tr><td>Crop:</td><td colspan="6">Strawberry (Fragarias x ananassa ‘Wendy’)</td></tr>
<tr><td>Disease name:</td><td colspan="6">Anthracnose fruit rot</td></tr>
<tr><td>Pathogen:</td><td colspan="6">Colletotrichum acutatum</td></tr>
<tr><td>Test plot design:</td><td colspan="6">Randomized complete block</td></tr>
<tr><td>Number of replicates:</td><td colspan="6">4</td></tr>
<tr><td>Application equipment:</td><td colspan="6">Handheld Smith Contractor Sprayer (29 psi)</td></tr>
<tr><td>Spray volume:</td><td colspan="6">75 gal/acre</td></tr>
<tr><td>Application type(s):</td><td colspan="6">Preventative</td></tr>
<tr><td>Number of applications:</td><td colspan="6">7</td></tr>
<tr><td rowspan="9">Chronology:</td><td colspan="4">Application</td><td rowspan="2">Disease Assessment Dates</td><td rowspan="2">Harvest Dates</td></tr>
<tr><td>No.</td><td>Date</td><td>Interval</td><td>Growth Stage</td></tr>
<tr><td>1</td><td>05/09/2016</td><td></td><td>Green up</td><td rowspan="7">06/23/2016</td><td rowspan="7">06/16/2016
06/24/2016</td></tr>
<tr><td>2</td><td>05/18/2016</td><td>9 days</td><td>Bloom</td></tr>
<tr><td>3</td><td>05/24/2016</td><td>6 days</td><td>2nd bloom after frost</td></tr>
<tr><td>4</td><td>06/01/2016</td><td>7 days</td><td>Bloom and green fruit</td></tr>
<tr><td>5</td><td>06/07/2016</td><td>6 days</td><td>Green fruit</td></tr>
<tr><td>6</td><td>06/15/2016</td><td>7 days</td><td>Green and red fruit</td></tr>
<tr><td>7</td><td>06/23/2016</td><td>8 days</td><td>Red fruit</td></tr>
<tr><td>Disease assessment methodology:</td><td colspan="6">• Visual field ratings: 50 berries were selected randomly.
• Disposable gloves were used to pick berries and changed between plots to reduce cross-contamination.
• Harvest was from the center of plots.
• Post-harvest: 25 marketable berries from each plot were placed equidistant on metal screens in aluminum trays and incubated at 72°F and 100% relative humidity. After 4 days, the berries were inspected for fungal sporulation.</td></tr>
</table>

b. Results

Strawberries /Anthracnose Fruit Rot (*Colletotrichum acutatum*) #1: Trial No. KAK-2016-Sberry-MI: Results								
Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	Field Incidence (%)		4-Day Post-Harvest Marketable Fruit [A] (1st Harvest; 6/16/2016)	
					Measured	Percent Control	Incidence (%)	Percent Increase
Untreated control			Not Applicable		27.0 a		7.5 a	
Oso 5%SC	6.5 fl oz	25	Polyoxin D zinc salt	19	5.5 b	80	28.0 bc	273
Oso 5%SC	13 fl oz	50	Polyoxin D zinc salt	19	4.0 bc	85	25.0 b	233
Serifel	4 oz		*Bacillus amyloliquefanciens* strain MBI 600	44	5.0 b	80	27.0 bc	260
Serifel	4 oz		*Bacillus amyloliquefanciens* strain MBI 600	44	5.0 b	81	38.0 c	407
Pristine	11.5 oz		Boscalid	7				
			Pyraclostrobin	11				

Treatment means followed by the same letter are not statistically different according to Fisher's Protected LSD test at $P \leq 0.05$.

A. Harvested 1 day after last application. All berries used in the post-harvest incubation test appeared marketable (no visible disease or soft areas) before incubation started.

The first assessments were performed after the last treatment. Therefore, all treatments are assumed to be preventative.

The researchers reported that the Anthracnose incidence observed in the field on fruit was moderate.

No phytotoxicity was observed.

c. Discussion

In this trial, Oso applied at 6.5 fl oz/acre and 13 fl oz/acre provided:

- 80% and 85% control, respectively, of field incidence of anthracnose fruit rot on strawberries; and
- 273% and 233% increases, respectively, of 4-day post-harvest marketable fruit.

One OMRI-listed product was evaluated in this trial. Oso applied at 13 fl oz/acre provided *superior* field control of anthracnose on strawberries compared to Serifel.

#2: Trial No. KAK-2017-SBerry-MI

a. Design

Strawberries /Anthracnose Fruit Rot (*Colletotrichum acutatum*) #2: Trial No. KAK-2017-Sberry-MI: Design				
Title:	Evaluation of fungicides for control of leaf and fruit rot diseases in matted-row strawberry, 2017			
Author and affiliation:	A. M. C. Schilder, J. M. Gillett, and R. W. Sysak Michigan State University			
Publication:	PDMR (planned for fall 2018 publication)			
Location:	Camden, MI			
Crop:	Strawberry (*Fragaria* x *ananassa* 'Wendy')			
Disease name:	Anthracnose fruit rot			
Pathogen:	*Colletotrichum acutatum* and *Colletotrichum dematium*			
Test plot design:	Randomized complete block			
Number of replicates:	4			
Application equipment:	Smith Contractor Sprayer (29 psi)			
Spray volume:	75 gallons/acre			
Application type(s):	Preventative			
Number of applications:	5			
Chronology:	Application Dates	Application Interval (days)	Growth Stage	Disease Assessment Dates
	05/01/2017		Green up	06/22/2017 (field ratings)
	05/07/ 2017	7	50% bloom	06/26/2017 (post-harvest ratings)
	05/24/2017	17	Bloom	
	05/31/2017	7	Bloom and green fruit	
	06/14/2017	14	Red fruit	
Disease assessment methodology (post-harvest):	25 marketable berries from each plot were placed equidistantly on metal screens in aluminum trays and incubated at room temperature and 100% relative humidity. After 4 days, berries were visually assessed for final sporulation.			

b. Results

Strawberries /Anthracnose Fruit Rot (*Colletotrichum acutatum*) #2: Trial No. KAK-2017-Sberry-MI: Results									
Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	App Code	4-Day Post-Harvest			
						Colletotrichum acutatum		*Colletotrichum dematium*	
						Incidence (%)	Control (%)	Incidence (%)	Control (%)
Untreated control			Not Applicable			10.0 a		43.0 a	
Oso 5%	13 fl oz	50	Polyoxin D zinc salt	19	ABCDE	1.0 b	90	5.0 b	88
Conventional standard:									
Topsin	4.5 fl oz		Thiophanate-methyl	1	A	2.0 b	80	9.0 b	79
Captan 4L	3 qt		Captan	M4	A				
Fontelis	24 fl oz		Penthiopyrad	7	BCE				
Switch 62.5	12 oz		Cyprodinil	9	D				
			Fludioxonil	12					
Treatment means followed by the same letter are not statistically different according to the Fisher's Protected LSD test at P ≤ 0.05. Overall Severity = [(Incidence) x (Severity)] / 100.									

The researchers described the Botrytis disease pressure as moderately high.

No phytotoxicity was observed.

c. Discussion

In this trial, Oso applied at 13 fl oz/acre provided 90% and 88% control, of anthracnose on 4-day post-harvested strawberries caused by *Colletotrichum acutatum* and *Colletotrichum dematium*, respectively.

No OMRI-listed products were evaluated in this trial.

CROP GROUP 13: STRAWBERRIES / Leather Rot (*Phytophthora cactorum*)

#1: Trial No. KAK-2016-SBerry-MI

a. Design

Strawberries / Leather Rot (*Phytophthora cactorum*) #1: Trial No. KAK-2016-Sberry-MI: Design						
Title:	Evaluations of fungicides for control of leaf and fruit rot diseases in matted-row strawberry, 2016					
Author and affiliation:	A. M.C. Schilder, N. M. Gillett, and R. W. Sysak Michigan State University					
Publication:	PDMR (planned for fall 2018 publication)					
Location:	Camden, MI					
Crop:	Strawberry (*Fragarias* x *ananassa* 'Wendy')					
Disease name:	Leather rot					
Pathogen:	*Phytophthora cactorum*					
Test plot design:	Randomized complete block					
Number of replicates:	4					
Application equipment:	Handheld Smith Contractor Sprayer (29 psi)					
Spray volume:	75 gal/acre					
Application type(s):	Preventative					
Number of applications:	7					
Chronology:	Application				Disease Assessment Dates	Harvest Dates
	No.	Date	Interval	Growth Stage		
	1	05/09/2016		Green up	06/23/2016	06/16/2016 06/24/2016
	2	05/18/2016	9 days	Bloom		
	3	05/24/2016	6 days	2nd bloom after frost		
	4	06/01/2016	7 days	Bloom and green fruit		
	5	06/07/2016	6 days	Green fruit		
	6	06/15/2016	7 days	Green and red fruit		
	7	06/23/2016	8 days	Red fruit		
Disease assessment methodology:	• Visual field ratings: 50 berries were selected randomly. • Disposable gloves were used to pick berries and changed between plots to reduce cross-contamination. • Harvest was from the center of plots. • Post-harvest: 25 marketable berries from each plot were placed equidistant on metal screens in aluminum trays and incubated at 72°F and 100% relative humidity. After 4 days, the berries were inspected for fungal sporulation.					

b. Results

Strawberries / Leather Rot (*Phytophthora cactorum*) #1: Trial No. KAK-2016-Sberry-MI: Results									
Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	App Code	Field Incidence on Fruit (%)		4-Day Post-Harvest Marketable Fruit [A] (1st Harvest; 6/1462016)	
						Measured	Percent Control	Incidence (%)	Percent Increase
Untreated control			Not Applicable			31.0 a		7.5 a	
Oso 5%SC	6.5 fl oz	25	Polyoxin D zinc salt	19	1-7	5.0 b	84	28.0 bc	273
Oso 5%SC	13 fl oz	50	Polyoxin D zinc salt	19	1-7	0.5 cd	98	25.0 b	233
Serifel	4 oz		*Bacillus amyloliquefanciens* strain MBI 600	44	1-7	3.0 bc	90	27.0 bc	260
Serifel	4 oz		*Bacillus amyloliquefanciens* strain MBI 600	44	1-7	2.5 bc	92	38.0 c	407
Pristine	11.5 oz		Boscalid	7					
			Pyraclostrobin	11					
Treatment means followed by the same letter are not statistically different according to Fisher's Protected LSD test at $P \leq 0.05$. A. Harvested 1 day after last application. All berries used in the post-harvest incubation test appeared marketable (no visible disease or soft areas) before incubation started.									

The first assessments were performed after the last treatment. Therefore, all treatments are assumed to be preventative.

The researchers reported that the leather rot incidence observed on fruit in the field was moderate.

No phytotoxicity was observed.

c. Discussion

In this study, Oso applied at 6.5 fl oz/acre and 13 fl oz/acre provided:

- 84% and 98% control, respectively, of in-field incidence of leather rot on strawberries; and
- 273% and 233% increases, respectively, of 4-day post-harvest marketable fruit.

One OMRI listed product was evaluated in this trial. Oso applied at 13 fl oz/ acre provided *superior* control of field incidence of leather rot on strawberries compared to Serifel.

#2: Trial No. KAK-2017-SBerry-MI

a. Design

Strawberries / Leather Rot (*Phytophthora cactorum*) #2: Trial No. KAK-2017-Sberry-MI: Design				
Title:	Evaluation of fungicides for control of leaf and fruit rot diseases in matted-row strawberry, 2017			
Author and affiliation:	A. M. C. Schilder, J. M. Gillett, and R. W. Sysak Michigan State University			
Publication:	PDMR (planned for fall 2018 publication)			
Location:	Camden, MI			
Crop:	Strawberry (*Fragaria* x *ananassa* 'Wendy')			
Disease name:	Leather rot			
Pathogen:	*Phytophthora cactorum*			
Test plot design:	Randomized complete block			
Number of replicates:	4			
Application equipment:	Smith Contractor Sprayer (29 psi)			
Spray volume:	75 gallons/acre			
Application type(s):	Preventative			
Number of applications:	5			
Chronology:	Application Dates	Application Interval (days)	Growth Stage	Disease Assessment Dates
	05/01/2017		Green up	06/22/2017 (field ratings)
	05/07/ 2017	7	50% bloom	06/26/2017 (post-harvest ratings)
	05/24/2017	17	Bloom	
	05/31/2017	7	Bloom and green fruit	
	06/14/2017	14	Red fruit	
Disease assessment methodology (post-harvest):	25 marketable berries from each plot were placed equidistantly on metal screens in aluminum trays and incubated at room temperature and 100% relative humidity. After 4 days, berries were visually assessed for final sporulation.			

b. Results

Strawberries / Leather Rot (*Phytophthora cactorum*) #2: Trial No. KAK-2017-Sberry-MI: Results									
Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	App Code	Field Rating of Leather Rot on Fruit		4-Day Post-Harvest Marketable Fruit	
						Incidence (%)	Control (%)	Incidence (%)	Increase (%)
Untreated control			Not Applicable			56.8 a		2.0 a	
Oso 5%	13 fl oz	50	Polyoxin D zinc salt	19	ABCDE	10.8 b	81	49.0 b	2350
Conventional standard:									
Topsin	4.5 fl oz		Thiophanate-methyl	1	A	7.5 b	87	40.0 b	1900
Captan 4L	3 qt		Captan	M4	A				
Fontelis	24 fl oz		Penthiopyrad	7	BC E				
Switch 62.5	12 oz		Cyprodinil	9	D				
			Fludioxonil	12					
Treatment means followed by the same letter are not statistically different according to the Fisher's Protected LSD test at P ≤ 0.05.									

The researchers described the leather rot disease pressure as moderately high.

No phytotoxicity was observed.

c. Discussion

In this trial, Oso applied at 13 fl oz/acre provided:

- 81% control of leather rot; and
- a 2350% increase in 4-day post-harvest marketable strawberries.

No OMRI-listed products were evaluated in this trial.

CROP GROUP 13: STRAWBERRIES / Phomopsis Leaf Spot *(Phomopsis obscurans)*

#1 Trial No. KAK-2016-SBerry-MI

a. Design

<table>
<tr><td colspan="6">Strawberries / Phomopsis Leaf Spot (Phomopsis obscurans) #1:
Trial No. KAK-2016-Sberry-MI: Design</td></tr>
<tr><td>Title:</td><td colspan="5">Evaluations of fungicides for control of leaf and fruit rot diseases in matted-row strawberry, 2016</td></tr>
<tr><td>Author and affiliation:</td><td colspan="5">A. M.C. Schilder, N. M. Gillett, and R. W. Sysak
Michigan State University</td></tr>
<tr><td>Publication:</td><td colspan="5">PDMR (planned for fall 2018 publication)</td></tr>
<tr><td>Location:</td><td colspan="5">Camden, MI</td></tr>
<tr><td>Crop:</td><td colspan="5">Strawberry (Fragarias x ananassa ‘Wendy’)</td></tr>
<tr><td>Disease name:</td><td colspan="5">Phomopsis leaf spot</td></tr>
<tr><td>Pathogen:</td><td colspan="5">Phomopsis obscurans</td></tr>
<tr><td>Test plot design:</td><td colspan="5">Randomized complete block</td></tr>
<tr><td>Number of replicates:</td><td colspan="5">4</td></tr>
<tr><td>Application equipment:</td><td colspan="5">Handheld Smith Contractor Sprayer (29 psi)</td></tr>
<tr><td>Spray volume:</td><td colspan="5">75 gal/acre</td></tr>
<tr><td>Application type(s):</td><td colspan="5">Preventative</td></tr>
<tr><td>Number of applications:</td><td colspan="5">7</td></tr>
<tr><td rowspan="9">Chronology:</td><td colspan="4">Application</td><td rowspan="2">Disease Assessment Dates</td><td rowspan="2">Harvest Dates</td></tr>
<tr><td>No.</td><td>Date</td><td>Interval</td><td>Growth Stage</td></tr>
<tr><td>1</td><td>05/09/2016</td><td></td><td>Green up</td><td rowspan="7">06/23/2016</td><td rowspan="7">06/16/2016
06/24/2016</td></tr>
<tr><td>2</td><td>05/18/2016</td><td>9 days</td><td>Bloom</td></tr>
<tr><td>3</td><td>05/24/2016</td><td>6 days</td><td>2nd bloom after frost</td></tr>
<tr><td>4</td><td>06/01/2016</td><td>7 days</td><td>Bloom and green fruit</td></tr>
<tr><td>5</td><td>06/07/2016</td><td>6 days</td><td>Green fruit</td></tr>
<tr><td>6</td><td>06/15/2016</td><td>7 days</td><td>Green and red fruit</td></tr>
<tr><td>7</td><td>06/23/2016</td><td>8 days</td><td>Red fruit</td></tr>
<tr><td>Disease assessment methodology:</td><td colspan="5">Visual field ratings: 25 leaves were randomly selected.
Post-harvest ratings: 25 marketable berries form each plot were placed equidistantly on metal screens on aluminum trays and incubated at 72°F and 100% relative humidity. After 4 days, berries were assessed visually for fungal sporulation and disease incidence for individual pathogens.</td></tr>
</table>

b. Results

Strawberries / Phomopsis Leaf Spot *(Phomopsis obscurans)* #1: Trial No. KAK-2016-Sberry-MI: Field Results								
Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	Leaves			
					Incidence (%)	Severity (%)	Overall (%)	Control (%)
Untreated control			Not Applicable		10.3 a	39.5 a	4.1 a	
Oso 5%SC	6.5 fl oz	25	Polyoxin D zinc salt	19	2.0 b	2.9 b	0.06 b	98
Oso 5%SC	13 fl oz	50	Polyoxin D zinc salt	19	0.0 c	0.0 c	0.0 b	100
Serifel	4 oz		*Bacillus amyloliquefanciens* strain MBI 600	44	1.0 bc	1.8 bc	0.03 b	99
Serifel	4 oz		*Bacillus amyloliquefanciens* strain MBI 600	44	0.5 c	0.8 bc	0.02 b	99
Pristine	11.5 oz		Boscalid	7				
			Pyraclostrobin	11				
Treatment means followed by the same letter are not statistically different according to Fisher's Protected LSD test at $P \leq 0.05$.								

The first assessments were performed after the last treatment. Therefore, all treatments are assumed to be preventative.

The researchers described the Phomopsis leaf spot incidence and severity on leaves as low.

No phytotoxicity was observed.

Strawberries / Phomopsis Fruit Rot *(Phomopsis obscurans)* #1: Trial No. KAK-2016-Sberry-MI: 4-Day Post-Harvest Results								
Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	Marketable Fruit			
					Harvest 1		Harvest 2	
					Incidence (%)	Increase (%)	Incidence (%)	Increase (%)
Untreated control			Not Applicable		7.5 a		15.0 a	
Oso 5%SC	6.5 fl oz	25	Polyoxin D zinc salt	19	28.0 bc	273	46.0 bc	207
Oso 5%SC	13 fl oz	50	Polyoxin D zinc salt	19	25.0 b	233	62.0 bc	313
Serifel	4 oz		*Bacillus amyloliquefanciens* strain MBI 600	44	27.0 bc	260	47.0 bc	213
Serifel	4 oz		*Bacillus amyloliquefanciens* strain MBI 600	44	38.0 c	407	68.0 bc	353
Pristine	11.5 oz		Boscalid	7				
			Pyraclostrobin	11				
Treatment means followed by the same letter are not statistically different according to Fisher's Protected LSD test at $P \leq 0.05$.								

c. Discussion

In this trial, Oso applied at 6.5 fl oz/acre and 13 fl oz/acre provided:

- 98% and 100% control, respectively, of Phomopsis leaf spot on strawberry leaves; and
- Up to 273% and 313% increase, respectively, in marketable strawberries.

One OMRI-listed products was evaluated in this trial. Oso applied at 13 fl oz/acre provided:

- *Superior* control of Phomopsis leaf spot compared to Serifel; and
- *Superior* control of Phomopsis fruit rot compared to Serifel.

#2 Trial No. KAK-2017-SBerry-MI

a. Design

Strawberries / Phomopsis Leaf Spot and Fruit Rot (*Phomopsis obscurans*) #2: Trial No. KAK-2017-Sberry-MI: Design				
Title:	Evaluation of fungicides for control of leaf and fruit rot diseases in matted-row strawberry, 2017			
Author and affiliation:	A. M. C. Schilder, J. M. Gillett, and R. W. Sysak Michigan State University			
Publication:	PDMR (planned for fall 2018 publication)			
Location:	Camden, MI			
Crop:	Strawberry (*Fragaria* x *ananassa* 'Wendy')			
Disease name:	Phomopsis leaf spot and fruit rot			
Pathogen:	*Phomopsis obscurans*			
Test plot design:	Randomized complete block			
Number of replicates:	4			
Application equipment:	Smith Contractor Sprayer (29 psi)			
Spray volume:	75 gallons/acre			
Application type(s):	Preventative			
Number of applications:	5			
Chronology:	Application Dates	Application Interval (days)	Growth Stage	Disease Assessment Dates
	05/01/2017		Green up	06/22/2017 (field ratings)
	05/07/ 2017	7	50% bloom	06/26/2017 (post-harvest ratings)
	05/24/2017	17	Bloom	
	05/31/2017	7	Bloom and green fruit	
	06/14/2017	14	Red fruit	
Disease assessment methodology (post-harvest):	25 marketable berries from each plot were placed equidistantly on metal screens in aluminum trays and incubated at room temperature and 100% relative humidity. After 4 days, berries were visually assessed for final sporulation.			

b. Results

Strawberries / Phomopsis Leaf Spot *(Phomopsis obscurans)* #2:
Trial No. KAK-2017-Sberry-MI: Results: Field Ratings

Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	App Code	Field Rating of Leaves for Phomopsis Leaf Spot			
						Incidence (%)	Severity (%)	Overall Severity (%)	Control (%)
Untreated control			Not Applicable			35.1 a	15.5 a	5.4 a	
Oso 5%	13 fl oz	50	Polyoxin D zinc salt	19	ABCDE	17.4 b	4.6 b	0.8 b	83
Topsin	4.5 fl oz		Thiophanate-methyl	1	A	15.9 b	5.3 b	0.9 b	87
Captan 4L	3 qt		Captan	M4	A				
Fontelis	24 fl oz		Penthiopyrad	7	BC E				
Switch 62.5	12 oz		Cyprodinil	9	D				
			Fludioxonil	12					

Treatment means followed by the same letter are not statistically different according to the Fisher's Protected LSD test at $P \leq 0.05$.

Overall Severity = [(Incidence) x (Severity)] / 100.

Strawberries / Phomopsis Fruit Rot *(Phomopsis obscurans)* #2:
Trial No. KAK-2017-Sberry-MI: Post-Harvest Results

Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	App Code	4-Day Post-Harvest Phomopsis Fruit Rot		4-Day Post-Harvest Marketable Fruit	
						Incidence (%)	Control (%)	Incidence (%)	Increase (%)
Untreated control			Not Applicable			20.0 a		2.0 a	
Oso 5%	13 fl oz	50	Polyoxin D zinc salt	19	ABCDE	4.0 b	80	49.0 b	2350
Conventional standard:									
Topsin	4.5 fl oz		Thiophanate-methyl	1	A	3.0 b	85	40.0 b	1900
Captan 4L	3 qt		Captan	M4	A				
Fontelis	24 fl oz		Penthiopyrad	7	BC E				
Switch 62.5	12 oz		Cyprodinil	9	D				
			Fludioxonil	12					

Treatment means followed by the same letter are not statistically different according to the Fisher's Protected LSD test at $P \leq 0.05$.

The researchers described the Phomopsis *leaf spot* field incidence as moderate and the overall Phomopsis leaf spot severity as low.

The researchers described the post-harvest Phomopsis *fruit rot* incidence as moderately low.

No phytotoxicity was observed.

c. Discussion

In this trial, Oso applied at 13 fl oz/acre provided:

- 83% control of Phomopsis leaf spot on strawberry leaves;
- 80% control of 4-day post-harvest Phomopsis fruit rot; and
- a 2350% post-harvest increase in marketable fruit.

No OMRI-listed products were evaluated in this trial.

CROP GROUP 19: HERBS AND SPICES: BASIL / Downy Mildew (*Peronospora belbahrii*)

#1: Trial No. IND-2015-218

a. Design

Basil / Downy Mildew (*Peronospora belbahrii*) #1: Trial No. IND-2015-218: Design			
Title:	Evaluation of biopesticides for downy mildew in basil with a potted plant assay		
Author and affiliation:	Margaret Tuttle McGrath Cornell University		
Publication:	PDMR 10:V034		
Location:	Greenhouse, then field (Riverhead, New York)		
Crop:	Basil (variety not specified)		
Disease name:	Downy mildew		
Pathogen:	*Peronospora belbahrii*		
Test plot design:	Not applicable		
Number of replicates:	1 replicate; 10 seedlings/treatment		
Application equipment:	Not applicable		
Spray volume:	Seedling dipped into fungicide solutions		
Application type(s):	Preventative		
Number of applications:	1		
Chronology:	Application Dates	Application Interval	Disease Assessment Dates
	09/22/2015	NA	09/30/2015
Methodology:	Potted seedlings were dipped into treatment solutions instead of sprayed with treatment solution to ensure contact of the treatment solution with both sides of the basil leaves. The dipped potted seedlings were allowed to dry in the greenhouse overnight. During the next approximately 72 hours, the seedlings were outdoors during daytimes and in the greenhouse in garbage bags during nighttimes for high humidity to promote spore production.		

b. Results

Basil / Downy Mildew (*Peronospora belbahrii*) #1: Trial No. IND-2015-218: Results									
Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	Severity (%) 10/13/2015		Incidence (%) 10/09/2015		Mean Percent Control
					Measured	Percent Control	Measured	Percent Control	
Untreated control			Not Applicable		45.3		100		
Oso	13 fl oz	50	Polyoxin D zinc salt	19	16.7	63.1	60	40	52
Actinovate AG	12 oz		*Streptomyces lydicus* WYEC 108	NC	40.0	1.15	80	20	11
Double Nickel	1.5 lb		*Bacillus amyloliquefaciens* str. D747	44	35.7	21.2	80	20	21
MilStop	3 lb		Potassium bicarbonate	NC	38.3	15.5	30	70	43
Trilogy	1%		Neem oil	NC	18.3	59.6	50	50	55
Regalia	2 qt		*Reynoutria sachalinensis* extract	P5	28.8	36.4	20	80	58
Sil-Matrix	3 qt		Potassium silicate	NC	18.0	60.3	20	80	70
Cueva	4 qt		Copper octanoate	M1	NA	NA	0	100	100
Revus	8 fl oz		Mandipropamid	40	40.0	11.7	10	90	51
NC = Not classified.									

The researcher did not comment of the relative downy mildew disease incidence or severity.

No phytotoxicity was reported.

c. Discussion

In this trial, Oso applied at 13 fl oz/acre provided 52% control of downy mildew on basil.

With the exception of Revus, all of the alternative treatments are OMRI-listed. Based upon this trial, Oso applied at 13 fl oz/acre provided control of downy mildew on basil that was:

- *Superior* to that provided by Actinovate AG, Double Nickel, and MilStop;
- *Similar* to that provided by Trilogy; and
- Inferior to that provided by Regalia, Sil-Matrix, and Cueva.

NEW EFFICACY DATA FOR USES INCLUDED IN THE MAY 31, 2016 PETITION

CROP GROUP 4: LEAFY VEGETABLES: SPINACH / White Rust (*Albugo occidentalis*)

#2: Trial No. CER-2015-152

a. Design

Spinach / White Rust (*Albugo occidentalis*) #2: Trial No. CER-2015-152: Design			
Title:	2015-2016 Fungicide Trial for Control of Spinach White Rust		
Author and affiliation:	Larry Stein and Marcel Valdez, Texas A&M AgriLife Extension Service; and Devin Kerstetter and Tyler Knight, Del Monte Corporation		
Publication:	Not published		
Location:	Del Monte Research Farm near Crystal City, TX		
Crop:	Spinach (variety Viroflay)		
Disease name:	White rust		
Pathogen:	*Albugo occidentalis*		
Test plot design:	Not reported		
Number of replicates:	Not reported		
Application equipment:	Foliar spray		
Spray volume:	15 gallon/acre		
Application type(s):	Preventative		
Number of applications:	4		
Chronology:	Application Dates	Application Interval	Disease Assessment Dates
	2015/12/11		2016/01/19
	2015/12/23	14 days	2016/01/29
	2016/01/08	15 days	
	2016/01/19	11 days	
Disease assessment rating:	1 = No white rust. 10 = Blown out.		

b. Results

Spinach / White Rust (*Albugo occidentalis*) #2: Trial No. CER-2015-152: Results							
Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	App Code	Disease Rating [A] 01/29/2016	
						Measured	Percent Control
Untreated control			Not Applicable			4.5 c	
Oso	6.5 fl oz	25	Polyoxin D zinc salt	19	ABCD	2.3 a	49
Induce	4 oz		Non-ionic wetter/spreader	NA			
Orondis	4.8 oz		Mandipropamid	40	ABCD	2.0 a	55
Induce	4 oz		Non-ionic wetter/spreader	NA			
Actinovate	6 oz		*Streptomyces lydicus* WYEC 108	NC	ABCD	2.0 a	55
Induce	4 oz		Non-ionic wetter/spreader	NA			
Zampro	14 oz		Ametoctradin	45	ABCD	2.0 a	55
			Dimethomorph	40			
Induce	4 oz		Non-ionic wetter/spreader	NA			
Double Nickel LC	1 qt		*Bacillus amyloliquefaciens* str. D747	44	AC	3.5 b	22
Cueva	20 oz		Copper octanoate	M1	BD		
Induce	4 oz		Non-ionic wetter/spreader	NA	ABCD		
Treatment means followed by the same letter are not statistically different. She statistical test and significance criteria were was not reported. A. Disease rating: 1 = No white rust. 10 = Blown out.							

On January 19, 2015, the last application was made and disease was first observed. Therefore, the first three applications were preventative and the last application was curative.

The researchers indicated that the disease pressure was low.

Upon returning to the trial site on February 12, 2016 to make the final rating and to determine the main cause of the problems, the trial had been destroyed by feral hogs. Nonetheless, the data provide for comparison of disease control through January 29, 2016, *i.e.*, 10 days after the last treatment.

Please note that the no white rust rating is 1 in this trial and was 0 in the 2014 trial.

No phytotoxicity was observed.

c. Discussion

In this trial, Oso applied at 6.5 fl oz/acre tank-mixed with Induce (a non-ionic wetter/spreader) provided 49% control of white rust on spinach.

OMRI-listed products evaluated in this trial included Actinovate, Double Nickel LC, and Cueva. Based upon this trial, Oso applied at 6.5 fl oz/acre provided control of white rust on spinach that was:

- Statistically *equivalent* to that provided by Actinovate; and
- Statistically *superior* to that provided by alternate applications of Double Nickel and Cueva.

CROP GROUP 11: POME FRUITS

APPLE / Powdery Mildew Storage Rot (*Podosphaera leuotricha*)

#4: Trial No. CER-2015-033

a. Design

<table>
<tr><th colspan="5">Apple / Powdery Mildew Storage Rot (Podosphaera leuotricha) #4:
Trial No. CER-2015-033: Design</th></tr>
<tr><td>Title:</td><td colspan="4">Evaluation of the Efficacy of Oso 5%SC Fungicide, Cueva and Double Nickel LC Against Common Storage Rot Pathogens on Apples</td></tr>
<tr><td>Author and affiliation:</td><td colspan="4">Ron Britt
Ron Britt & Associates</td></tr>
<tr><td>Publication:</td><td colspan="4">Not published</td></tr>
<tr><td>Location:</td><td colspan="4">Wapato, Washington</td></tr>
<tr><td>Crop:</td><td colspan="4">Apples (Granny Smith)</td></tr>
<tr><td>Disease name:</td><td colspan="4">Powdery mildew storage rot</td></tr>
<tr><td>Pathogen:</td><td colspan="4">Podosphaera leucotricha</td></tr>
<tr><td>Test plot design:</td><td colspan="4">Randomized compete block</td></tr>
<tr><td>Number of replicates:</td><td colspan="4">4</td></tr>
<tr><td>Application equipment:</td><td colspan="4">Rears airblast sprayer (110 psi)</td></tr>
<tr><td>Spray volume:</td><td colspan="4">100 gallons/acre</td></tr>
<tr><td>Application type(s):</td><td colspan="4">Preventative (not evaluated for powdery mildew before application)</td></tr>
<tr><td>Number of applications:</td><td colspan="4">1</td></tr>
<tr><td rowspan="2">Chronology:</td><td>Application Dates</td><td>Application Interval</td><td>Harvest Date</td><td>Disease Assessment Dates</td></tr>
<tr><td>09/29/2015</td><td>NA</td><td>Not reported</td><td>12/14/2015
12/15/2015
02/03/2016
02/05/2016</td></tr>
<tr><td>Disease assessment methodology:</td><td colspan="4">For each treatment, 200 apples were harvested. The skin of 100 apples were punctured with a wire to facilitate infection. 100 apples were not punctured. Apples were placed into cold storage.
<u>Evaluation of punctured apples</u>:
0 = No infection.
1 = Infection at the site of the puncture.
2 = Infection spread past the puncture site.
<u>Evaluation of apples not punctured</u>:
0 = No infection.
1 = Less than 2% apple surface was infected.
2 = More than 2% apple surface was infected.</td></tr>
</table>

b. Results

Apple / Powdery Mildew Storage Rot (*Podosphaera leuotricha*) #4: Trial No. CER-2015-033: Results								
Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	Incidence (%) Not Punctured 2/5/2016		Incidence (%) Punctured 2/3/2016	
					Measured	Percent Control	Measured	Percent Control
Untreated control			Not Applicable		55.5 a		96.0 a	
Oso	6.5	25	Polyoxin D zinc salt	19	49.2 a	11.4	87.0 a	9.4
R-56	0.25% (v/v)		Sticker/spreader	NA				
Cueva	2 qt		Copper octanoate	M1	56.0 a	-0.9	92.2 a	4.0
Double Nickel	1 qt		*Bacillus amyloliquefaciens* str. D747	44	57.5 a	-3.6	95.5 a	0.5
Double Nickel	2 qt		*Bacillus amyloliquefaciens* str. D747	44	52.5 a	5.4	96.5 a	0.5
Treatment means followed by the same letter are not statistically different according to the LSD test at P = 0.05.								

The researcher did not describe the relative powdery mildew storage rot disease pressure.

c. Discussion

Based upon this trial, Oso field applied at 6.5 fl oz/acre tank-mixed with R-56 (a sticker-spreader) provided 11.4% and 9.4% decreased incidence of powdery mildew storage rot of apples that were not punctured and punctured, respectively, before storage.

The OMNI-listed products evaluated in this trial included Cueva and Double Nickel. Based upon this trial:

- Oso provided *superior* control of powdery mildew storage rot of apples compared to both Cueva and Double Nickel.
- Cueva at 2 qt/acre and Double Nickel at 1 qt/acre were *ineffective* against powdery mildew storage rot of apples for apples not punctured prior to storage, *i.e.*, disease incidence for these treatments exceeded the disease incidence in the untreated control.

CROP GROUP 12: STONE FRUITS: CHERRIES / Powdery Mildew (*Podosphaera clandestina*)

Cherries #2: Trial No. CER-2015-035

a. Design

Cherries / Powdery Mildew (*Podosphaera clandestina*) #2: Trial No. CER-2015-035: Design					
Title:	Comparison of fungicides for management of cherry diseases, 2015				
Authors and affiliation:	J. W. Pscheidt, John P. Bassinette, and L. A. Jones Oregon State University				
Publication:	PDMR 10:STF009				
Location:	Corvallis, OR				
Crop:	Sweet cherry ('Bing')				
Disease name:	Powdery mildew				
Pathogen:	*Podosphaera clandestina*				
Test plot design:	Randomized complete block				
Number of replicates:	Not reported				
Application equipment:	Hydraulic handgun sprayer (100 psi)				
Spray volume:	164 gal/acre				
Application type:	Preventative and curative				
Number of applications:	7 (all pre-harvest)				
Chronology:	Application Dates	Growth Stage	Application Intervals	Brown Rot Blossom Blight Assessment Dates	Harvest Date
	03/26/2015	Popcorn		04/14/2015	06/10/2015
	04/02/2015	Full bloom	7 days		
	04/15/2015	Petal fall	13 days		
	04/29/2015	Fruit set	14 days		
	05/12/2015		13 days		
	05/26/2015		14 days		
	06/09/2015	Pre-harvest	14 days		

b. Results

Cherries / Powdery Mildew (*Podosphaera clandestina*) #2: Trial No. CER-2015-035: Results						
Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	Powdery Mildew (Leaves) (%)	
					Measured	Percent Control
Untreated control			Not Applicable		53.5 a	
Oso 5%SC	6.5 fl oz	25	Polyoxin D zinc salt	19	43.0 ab	19.6
Induce	32 fl oz/100 gal		Non-ionic wetter/spreader	NA		
Merivon	6 fl oz		Fluxapyroxad	7	17.5 cde	67.3
			Pyraclostrobin	11		
Induce	32 fl oz/100 gal		Non-ionic wetter/spreader	NA		

Symptoms of powdery mildew were first observed and confirmed on May 18, 2015, *i.e.*, after applications 1-5 and before applications 6-7. Therefore, the applications were preventative *and curative*.

The researchers described the disease pressure as low.

No phytotoxicity was observed.

c. Discussion

In this trial, Oso applied at 6.5 fl oz/acre tank-mixed with Induce (a non-ionic wetter/spreader) provided 19.6% control of powdery mildew on cherries.

No OMRI-listed products were evaluated in this trial.

CROP GROUP 13: BERRIES AND SMALL FRUITS: BLUEBERRIES / Mummyberry (*Monilinia vaccinii-corymbosi*)

#3: Trial No. KAK-2016-Blueberry-MI

a. Design

Blueberries / Mummyberry (*Monilinia vaccinii-corymbosi*) #3: Trial No. KAK-2016-Blueberry-MI: Design						
Title:	Evaluating fungicides for control of mummy berry and post-harvest fruit rot in blueberries, 2016.					
Author and affiliation:	A. M. C. Schilder, J. M. Gillett, and R. W. Sysak Michigan State University					
Publication:	PDMR (planned for fall 2018 publication)					
Location:	Bangor, MI					
Crop:	Blueberry (*Vaccinium corymbosum* 'Berkeley')					
Disease name:	Mummy berry					
Pathogen:	*Monilinia vaccinii-corymbosi*					
Test plot design:	Randomized complete block					
Number of replicates:	4					
Application equipment:	Hand-held Smith Contractor Sprayer (29 psi)					
Spray volume:	40 gallons/acre through May 19, 2016. 50 gallons/acre thereafter.					
Application type(s):	Preventative					
Number of applications:	4 (Shoot strike evaluations) 8 (Mummies per bush evaluations)					
Chronology:	Application			Growth Stage	Disease Assessment Dates	Harvest Date
	No.	Dates	Interval			
	1	04/18/2016		Early green tip; apothecia cup ave. diameter 1/8 inch	05/16/2016	07/14/2016
	2	04/26/2016	8 days	Late green tip with some early pink bud; apothecia cup ave. diameter 1/4 inch	05/25/2016	
	3	05/06/2016	13 days	Pink bud with some early bloom	07/08/2016	
	4	05/19/2016	13 days	Bloom, some apothecia sill present		
	6	05/31/2016	12 days	Petal fall		
	7	06/14/2016	15 days	Green fruit		
	8	07/07/2016	23 days	10% blue fruit		
Disease assessment methodology:	• Mummified berries on the ground were counted in a 6.5 x 6.5 foot section under the two center bush for each plot. • Fifty ripe berries per subplot were harvested, placed equidistantly on metal screens in aluminum trays and incubated at room temperature and 100% relative humidity. Ten days later, the berries were rated for post-harvest health by observing sporulation on the berries.					

b. Results

Blueberries / Mummyberry (*Monilinia vaccinii-corymbosi*) #3: Trial No. KAK-2016-Blueberry-MI: Results: Shoot Strikes							
Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	App. Code	No. Shoot Strikes per Bush (05/16/2016)	
						Measured	Percent Control
Untreated control			Not Applicable			57.8 a	
Oso 5%SC	6.5 fl oz	25	Polyoxin D zinc salt	19	1,2,3,4	5.3 cde	90.8
Oso 5%SC	6.5 fl oz	25	Polyoxin D zinc salt	19	1,2,3,4	7.0 bcde	87.9
LI 700	0.125% (v/v)		Penetrant, acidifier	NA			
Oso 5%SC	13 fl oz	50	Polyoxin D zinc salt	19	1,2,3,4	0.0 f	100
Double Nickel	1.06 qt		*Bacillus amyloliquefaciens* str. D747	44	1,2,3,4	12.0 b	79.2
Double Nickel	2.1 qt		*Bacillus amyloliquefaciens* str. D747	44	1,2,3,4	3.5 cdef	93.9
Kenja 400SC	13.5 fl oz		Isofetamid	7	1,2,3,4	7.0 bcde	87.9
Indar 2F	6 fl oz		Fenbuconazole	3	1,2,3,4	0.0 f	100
Oso 5%SC	6.5 fl oz	25	Polyoxin D zinc salt	19	1,3	0.0 f	100
LI 700	0.125% (v/v)		Non-ionic surfactant	NA			
Indar 2F	6 fl oz		Fenbuconazole	3	2,4		
Treatment means followed by the same letter are not statistically different according to the Fisher's Protected LSD test at P ≤ 0.05.							

Blueberries / Mummyberry (*Monilinia vaccinii-corymbosi*) #3 Trial No. KAK-2016-Blueberry-MI: Results: Field and Post-Harvest									
Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	App. Code	No. Mummies per Bush		Percent Healthy 10 Days Post-Harvest	
						Measured	Percent Control	Measured	Percent Increase
Untreated control			Not Applicable			32.3 a		70.0 ns	
Oso 5%SC	6.5 fl oz	25	Polyoxin D zinc salt	19	1,2,3,4,6,7,8	3.0 def	90.7	50.5	-27.9
Oso 5%SC	6.5 fl oz	25	Polyoxin D zinc salt	19	1,2,3,4,6,7,8	3.8 de	88.2	73.5	5.0
LI 700	0.125% (v/v)		Non-ionic surfactant	NA					
Oso 5%SC	13 fl oz	50	Polyoxin D zinc salt	19	1,2,3,4,6,7,8	0.0 f	100	73.5	5.0
Double Nickel	1.06 qt		*Bacillus amyloliquefaciens* str. D747	44	1,2,3,4,6,7,8	8.0 bc	75.2	73.5	5.0
Double Nickel	2.1 qt		*Bacillus amyloliquefaciens* str. D747	44	1,2,3,4,6,7,8	4.0 de	87.6	78.0	11.4
Kenja 400SC	13.5 fl oz		Isofetamid	7	1,2,3,4,6,7,8	6.0 cd	81.4	71.5	2.1
Indar 2F	6 fl oz		Fenbuconazole	3	1,2,3,4,6,7,8	0.0 f	100	71.5	2.1
Bravo Weather Stik	4 qt		Chlorothalonil	M5	1,3	0.0 f	100	75.0	7.1
Indar 2F	6 fl oz		Fenbuconazole	3	2,4,6				
Pristine	23 oz		Boscalid	7	7,8				
			Pyraclostrobin	11					
Oso 5%SC	6.5 fl oz	25	Polyoxin D zinc salt	19	1,3,6,8	0.0 f	100	75.0	7.1
LI 700	0.125% (v/v)		Non-ionic surfactant	NA					
Indar 2F	6 fl oz		Fenbuconazole	3	2,4				
Pristine	23 oz		Boscalid	7	7				
			Pyraclostrobin	11					
Treatment means followed by the same letter are not statistically different according to the Fisher's Protected LSD test at P ≤ 0.05. ns. No significant differences were found according to the Fisher's Protected LSD test at P ≤ 0.05.									

The first assessments were performed May 16, 2016, *i.e.*, after applications 1-3 and before applications 4-8. Disease was observed. Therefore:

- Applications 1 to 3 are assumed to be preventative, and
- Applications 4 to 8 were ***curative***.

No phytotoxicity was observed.

c. Discussion

In this trial:

- Oso applied at 6.5 fl oz/acre and 13 fl oz/acre provided 90.7% and 100% control, respectively, of Mummyberry on blueberry fruit.
- Oso was applied at 6.5 fl oz/acre with and without LI 700 (a non-ionic surfactant) as a tank-mix partner. Oso ***without*** LI 700 provided numerically ***superior*** control of the number of mummies per bush (90.7% control without LI 700 vs 88.2% control with LI 700).
- No statistical differences were observed in the 10-day post-harvest number of healthy blueberries.

The only OMRI-listed product evaluated in this trial was Double Nickel. Oso provided *superior* control the number of mummies per blueberry bush (90.7% and 100% control) compared to Double Nickel (75.2% and 87.6% control).

#4: Trial No. KAK-2016-Blueberry-WA-Conv

a. Design

Blueberries / Mummyberry (*Monilinia vaccinii-corymbosi*) #4: Trial No. KAK-2016-Blueberry-WA-Conv: Design				
Title:	Conventional Mummy Berry & Botrytis Control in Blueberries #2			
Author and affiliation:	Alan Schreiber Agricultural Development Group, Inc.			
Publication:	Not published; permission received.			
Location:	Mt. Vernon, Washington			
Crop:	Highbush Blueberry (variety: Reka)			
Disease name:	Mummy berry			
Pathogen:	*Monilinia vaccinii-corymbosi*			
Test plot design:	Randomized complete block			
Number of replicates:	4			
Application equipment:	Rears OverRo			
Spray volume:	100 gallons/acre			
Application type(s):	Preventative			
Number of applications:	6			
Chronology:	Application Dates	Application Intervals	Growth Stage	Disease Assessment Dates
	03/05/2016			05/03/2016
	03/16/2016	11 days		06/25/2016
	03/31/2016	15 days		
	04/15/2016	16 days	50% bloom	
	04/25/2016	10 days	80% bloom	
	05/06/2016	11 days		

b. Results

Blueberries / Mummyberry (*Monilinia vaccinii-corymbosi*) #4: Trial No. KAK-2016-Blueberry-WA-Conv: Results									
Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	App. Code	Incidence: Flower/Leaf Strikes per Plot (05/03/2016)		Incidence: Mummified Berries (06/25/2016)	
						Measured	Percent Control	Measured	Percent Control
Untreated control			Not Applicable			13.5 a		17.8 a	
Oso 5%SC	6.5 fl oz	25	Polyoxin D zinc salt	19	ABCDEF	2.3 b	83.0	2.8 b	84.3
Oso 5%SC	13 fl oz	50	Polyoxin D zinc salt	19	ABCDEF	2.3 b	83.0	2.3 b	87.1
Chlorothalonil	32 fl oz		Chlorothalonil	M5	A	0.8 b	94.1	0.3 b	98.3
Indar 2F	6 fl oz		Fenbuconazole	3	B				
Proline	5.7 fl oz		Prothioconazole	3	C				
Switch 62 WG	11 oz		Cyprodinil	9	D				
			Fludioxonil	12					
Pristine	18 oz		Boscalid	7	E				
			Pyraclostrobin	11					
Abound	10 fl oz		Azoxystrobin	11	F				
Elevate	1.5 lb		Fenhexamid	17	F				
Chlorothalonil	32 fl oz		Chlorothalonil	M5	A	0.8 b	94.1	2.8 b	84.3
Indar 2F	6 fl oz		Fenbuconazole	3	BC				
Switch	14 oz wt		Cyprodinil	9	D				
			Fludioxonil	12					
Indar 2F	6 fl oz		Fenbuconazole	3	AB	3.3 b	75.6	1.5 b	66.7
Pristine	20 oz		Boscalid	7	C				
			Pyraclostrobin	11					
Switch	14 oz wt		Cyprodinil	9	D				
			Fludioxonil	12					
Treatment means followed by the same letter are not statistically different according to Bartlett's X2 test at P = 0.05.									

The first treatment was applied March 5, 3016. Based upon feedback from Washington State University plant pathologists, this was prior to ascospore release (*i.e.*, prior to crop infection). Therefore, the treatments were applied preventatively.

The researcher described the mummyberry pressure as moderate.

No phytotoxicity was reported.

c. Discussion

In this trial, Oso applied at 6.5 fl oz/acre and 13 fl oz/acre provided:

- 83.0% control of flower/leaf strikes at both application rates; and
- 84.3% and 87.1% control, respectively, of the number of mummified berries.

No OMRI-listed products were evaluated in this trial.

#5: Trial No. KAK-2016-Blueberry-WA-Org

a. Design

Blueberries / Mummyberry (*Monilinia vaccinii-corymbosi*) #5: Trial No. KAK-2016-Blueberry-WA-Org: Design				
Title:	Organic Mummy Berry & Botrytis Control in Blueberries of Western Washington 2016			
Author and affiliation:	Alan Schreiber Agricultural Development Group, Inc.			
Publication:	Not published; permission received.			
Location:	Mt. Vernon, Washington			
Crop:	Highbush Blueberry (variety: Reka)			
Disease name:	Mummy berry			
Pathogen:	*Monilinia vaccinii-corymbosi*			
Test plot design:	Randomized complete block			
Number of replicates:	4			
Application equipment:	Rears OverRo			
Spray volume:	100 gallons/acre			
Application type(s):	Preventative			
Number of applications:	7			
Chronology:	Application Dates	Application Interval	Growth Stage	Evaluation Dates
	02/27/2016		Veg Bud	05/03/2016
	03/07/2016	9 days	Veg Tip	06/23/2016
	03/16/2016	9 days	Pre Bud	
	03/25/2016	9 days	Pink Bud	
	03/31/2016	6 days	10% Bloom	
	04/08/2016	9 days	30% Bloom	
	04/15/2016	7 days	50% Bloom	

b. Results

Blueberries / Mummyberry (*Monilinia vaccinii-corymbosi*) #5: Trial No. KAK-2016-Blueberry-WA-Org: Results									
Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	Appl Code	Incidence Leaf Strikes/Plot) (05/03/2016)		Incidence (Infected Fruit) (06/23/2016)	
						Measured	Percent Control	Measured	Percent Control
Untreated control			Not Applicable			16.0 abc		45.0 a	
Oso 5%SC	6.5 fl oz	25	Polyoxin D zinc salt	19	ABCDEF	26.3 a	-64.4	37.0 a	17.8
Oso 5%SC	13 fl oz	50	Polyoxin D zinc salt	19	ABCDEF	10.8 c	32.5	31.5 a	30.0
Fracture	20 fl oz		Banda de Lupinus albus doce (BLAD)	M12	ABCDEFG	21.0 abc	-31.3	39.8 a	11.6
Zen-O-Spore	4 lb		*Ulocladium oudemansii* (U3 Strain)	NC	ABCDEFG	18.0 abc	-12.5	32.5 a	27.8
Actinovate AG	12 oz		*Streptomyces lydicus* WYEC 108	NC	ABCDEFG	16.8 abc	-5.0	39.0 a	13.3
Double Nickel LC	1 qt		*Bacillus amyloliquefaciens* str. D747	44	ABCDEFG	12.8 bc	20.0	33.5 a	25.6
Regalia	2 qt		*Reynoutria sachalinensis* extract	P5	ABCDEFG	12.0 c	25.0	39.0 a	13.3
NovaSource's Lime-Sulfur	2% v/v		Calcium polysulfide	M2	ABCD	9.8 c	38.8	36.0 a	20.0
Oso 5%SC	13 fl oz		Polyoxin D zinc salt	19	BDF	25.3 ab	-58.1	24.3 a	46.0
Actinovate AG	12 oz		*Streptomyces lydicus* WYEC 108	NC	ACEG				
Oso 5%SC	13 fl oz		Polyoxin D zinc salt	19	BDF	20.8 abc	-30.0	32.8 a	27.1
Regalia	2 qt		*Reynoutria sachalinensis* extract	P5	ACEG				
Actinovate AG	12 oz		*Streptomyces lydicus* WYEC 108	NC	ACEG				
Oso 5%SC	13 fl oz		Polyoxin D zinc salt	19	EFG	15.8 abc	1.3	29.3 a	34.9
NovaSource's Lime-Sulfur	2% v/v		Calcium polysulfide	M2	ABCD				
Oso 5%SC	13 fl oz		Polyoxin D zinc salt	19	ACEG	21.5 abc	-34.4	25.8 a	42.7
Regalia	2 qt		*Reynoutria sachalinensis* extract	P5	BDF				
Actinovate AG	12 oz		*Streptomyces lydicus* WYEC 108	NC	ACEG	22.0 abc	-37.5	39.0 a	13.3
Regalia	2 qt		*Reynoutria sachalinensis* extract	P5	ACEG				
Double Nickel LC	1 qt		*Bacillus amyloliquefaciens* str. D747	44	BDF				
Zen-O-Spore	4 lb		*Ulocladium oudemansii* (U3 Strain)	NC	BDF				
Treatment means followed by the same letter are not statistically different according to Bartlett's X2 test at P = 0.05.									

The first application was made on February 27, 2016. Based upon feedback from Washington State University plant pathologists, this was prior to ascospore release (i.e., prior to crop infection). Therefore, the treatments were applied preventatively.

The researcher described the mummyberry pressure as moderate.

No phytotoxicity was reported.

c. Discussion

In this trial:

- Oso applied at 6.5 fl oz/acre provided no control of mummyberry leaf strike incidence and 17.8% control of fruit mummies; and
- Oso applied at 13 fl oz/acre provided 32.5% control of leaf strike incidence and 30.0% control of fruit mummies.

The reduction in efficacy observed on this trial compared to the nearby trial using conventional pesticides (Trial No. KAK-2016-Blueberry-WA-Conv) is postulated to be due to the "re-inoculation" of the Oso subplots by the surrounding subplots for the organic treatments with no or lesser mummyberry control.

OMRI-listed products evaluated in this trial as single product treatments included Actinovate AG, Double Nickel LC, Regalia, NovaSource's Lime-Sulfur, and Zen-O-Spore. (Based upon information on the Internet, Zen-O-Spore is not EPA registered for use on blueberries.) In these single product evaluations, Oso applied at 13 fl oz/acre provided:

- *Superior* control of fruit mummies for all evaluated OMRI-listed products;
- *Superior* control of leaf strike incidence compared to Zen-O-Spore, Actinovate AG, Double Nickel LC, and Regalia; and
- *Slightly less* control of leaf strike incidence than provided by Nova-Sources Lime-Sulfur (32.5% vs 38.8% control).

Actinovate AG, Double Nickel LC, Regalia, NovaSource's Lime-Sulfur were also evaluated as rotation partners with Oso at 13 fl oz/acre. For all of the evaluated rotations with Oso, the control of fruit mummies by Oso rotated with the OMRI-listed rotation partner was *superior* to the control provided by the OMRI-listed product used alone. Oso used in rotation with:

- Actinovate provided *superior* control of fruit mummies compared to Oso used alone and compared to Actinovate used alone.
- Regalia and Actinovate provided *superior* control of fruit mummies compared to Regalia used alone and compared to Actinovate used alone.
- NovaSource's Lime-Sulfur provided *superior* control of fruit mummies compared to Oso used alone and compared to NovaSource's Lime-Sulfur used alone.
- Regalia provided *superior* control of fruit mummies compared to Oso used alone and compared to Regalia used alone.

Fracture was also evaluated in this trial. Fracture is a biopesticide. Based upon the label posted to the Internet, Fracture is not an OMRI-listed product.

#6: Trial No. KAK-2017-Blueberry-WA-Org

a. Design

Blueberries / Mummyberry (*Monilinia vaccinii-corymbosi*) #6: Trial No. KAK-2017-Blueberry-WA-Org: Design					
Title:	Effect of Organic Fungicides on Blueberry Mummy Berry				
Author and affiliation:	T. Walters and A. Schreiber Agricultural Development Group, Inc.				
Publication:	Not published; permission.				
Location:	Near Mt. Vernon, Washington				
Crop:	Blueberries (highbush)				
Disease name:	Mummy berry				
Pathogen:	*Monilinia vaccinii-corymbosi*				
Test plot design:	Randomized complete block				
Number of replicates:	4				
Application equipment:	Over the row spray mount				
Spray volume:	64 gallons/acre				
Application type(s):	Preventative				
Number of applications:	8 (trial); 7 (Oso)				
Chronology:	Application Code	Application Dates	Application Interval (Days)		Disease Assessment Dates
			Trial	Oso	
	A	03/19/2017			07/07/2017
	B	03/30/2017	11	11	
	C	04/04/2017	5	5	
	D	04/11/2017	7	7	
	E	04/18/2017	7	7	
	F	04/25/2017	7	7	
	G	05/02/2017	7	18	
	H	05/13/2017	11		
Disease assessment methodology:	Number of infections per 100 randomly picked berries.				

b. Results

Blueberries / Mummyberry (*Monilinia vaccinii-corymbosi*) #6: Trial No. KAK-2017-Blueberry-WA-Org: Results							
Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	App. Code	Incidence (%)	
						Measured	Percent Control
Untreated control			Not Applicable			6.3 a	
Oso	6.5 fl oz	25	Polyoxin D zinc salt	19	ABCDEFH	2.3 de	63
Oso	13 fl oz	50	Polyoxin D zinc salt	19	ABCDEFH	2.0 de	68
Regalia	2 qt		*Reynoutria sachalinensis* extract	P5	ABCDEFGH	3.3 cde	48
Actinovate AG	12 oz		*Streptomyces lydicus* WYEC 108	NC	ABCDEFGH	3.8 bcde	40
Double Nickel LC	1 qt		*Bacillus amyloliquefaciens* str. D747	44	ABCDEFGH	5.5 ab	13
Oso	13 fl oz		Polyoxin D zinc salt	19	ABCDEFGH	2.0 de	68
Actinovate AG	12 oz		*Streptomyces lydicus* WYEC 108	NC	ABCDEFGH		
Stimplex	4.8 oz/10 gal		Cytokinin	NC	ABCDEFGH		
Oso	13 fl oz		Polyoxin D zinc salt	19	ABCDEFGH	1.8 e	71
Regalia	2 qt		*Reynoutria sachalinensis* extract	P5	ABCDEFGH		
Oso	13 fl oz		Polyoxin D zinc salt	19	BDF	3.3 cde	48
Regalia	2 qt		*Reynoutria sachalinensis* extract	P5	BDR		
Actinovate AG	12 oz		*Streptomyces lydicus* WYEC 108	NC	ACEGH		
Stimplex	4.8 oz/10 gal		Cytokinin	NC	ACEGH		
Oso	13 fl oz		Polyoxin D zinc salt	19	BDF	3.0 cde	52
Double Nickel LC	1 qt		*Bacillus amyloliquefaciens* str. D747	44	BDF		
Actinovate AG	12 oz		*Streptomyces lydicus* WYEC 108	NC	ACEGH		
Stimplex	4.8 oz/10 gal		Cytokinin	NC	ACEGH		
Oso	13 fl oz		Polyoxin D zinc salt	19	EFG	2.3 de	63
Lime-Sulfur Solution	2% v/v		Calcium polysulfide	M2	ABCDH		
Lime-Sulfur Solution	2 gal		Calcium polysulfide	M2	ABCD	4.0 bcd	37
Lime-Sulfur Solution	3.5 gal		Calcium polysulfide	M2	ABCD	4.0 bcd	37
Lime-Sulfur Solution	7.5 gal		Calcium polysulfide	M2	ABCD	2.5 de	60
Lime-Sulfur Solution	8 gal		Calcium polysulfide	M2	ABCD	1.8 e	71
Lime-Sulfur Solution	8 gal		Calcium polysulfide	M2	ACE	3.3 cde	48
Treatment means followed by the same letter are not statistically different (P = 0.05, LSD).							

Treatments were applied preventatively.

The researchers reported that the mummyberry disease pressure was low. Based upon communications with the lead researcher, the 2017 growing season was unusually dry.

No phytotoxicity was reported.

c. Discussion

In this trial, Oso applied at 6.5 fl oz/acre and 13 fl oz/acre provided 63% control and 68% control of blueberry mummies.

The following OMRI-listed products were also evaluated in this trial: Actinovate AG, Double Nickel LC, Regalia, and Lime-Sulfur Solution. Stimplex is an OMRI-listed biostimulant and was included in tank-mixes that were evaluated.

In this trial, Oso applied at 13 fl oz/acre provided:

- *Superior* control of mummyberry incidence compared to Actinovate AG, Double Nickel LC, Regalia, and Lime-Sulfur Solution (2 to 7.5 gal/acre) used alone; and
- Statistically *equivalent* control of mummyberry incidence compared to high dose Lime-Sulfur Solution (8 gal/acre).

In this trial, Oso applied at 13 fl oz/acre was used in rotation with Actinovate AG, Double Nickel LC, Regalia, and/or Lime-Sulfur Solution and sometimes Simplex. In these rotations, the efficacy of Oso in rotation with Actinovate AG, Double Nickel LC, Regalia, and/or Lime-Sulfur Solution was superior to the OMRI-listed products used alone.

CROP GROUP 13: BERRIES AND SMALL FRUITS: CANEBERRIES / Gray Mold (Botrytis sp.)

Raspberries #2: Trial No. IND-2016-Rasp-WA

a. Design

Raspberries /Botrytis Fruit Rot *(Botrytis* sp.) #2: Trial No. IND-2016-Rasp-WA: Design				
Title:	Raspberry Botrytis Field Efficacy Program - 2016			
Author and affiliation:	Tom Walters Agricultural Development Group, Inc.			
Publication:	Not published (permission)			
Location:	Everson, Washington			
Crop:	Raspberry (variety Meeker)			
Disease name:	Botrytis fruit rot			
Pathogen:	*Botrytis sp.*			
Test plot design:	Randomized complete block			
Number of replicates:	4			
Application equipment:	Rears OveRo (130 psi)			
Spray volume:	100 gal/acre			
Application type(s):	Preventative			
Number of applications:	6			
Chronology:	Application Date	Application Interval	Growth Stage	Disease Assessment Dates
	05/05/2016		10% bloom	07/09/2016
	05/16/2016	11 days	30% bloom	07/12/2016
	05/25/2016	9 days	50% bloom	
	06/07/2016	12 days	1st harvest	
	06/17/2016	10 days		
	06/29/2016	12 days	Mid-harvest	
Disease assessment methodology:	For each plot, all berries were inspected, and all infected berries were counted. A total of 5520 row feet (more than a mile) were examined at each evaluation.			

b. Results

Raspberries / Botrytis Fruit Rot *(Botrytis* sp.) #2: Trial No. IND-2016-Rasp-WA: Results						
Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	Incidence (No. Infected Berries/Plot) (07/12/2016)	
					Measured	Percent Control
Untreated control			Not Applicable		21.0 abc	
Oso 5SC	12 fl oz	46	Polyoxin D zinc salt	19	10.0 c	52.4
Oxidate	32 fl oz/ 100 gal		Hydrogen dioxide	NC	27.8 a	-32.4
PH~D 11.3WDG	6.2 oz		Polyoxin D zinc salt	19	19.8 abc	5.7
Elevate 50	1.5 lb		Fenhexamid	17	17.0 abc	19.0
Switch 62.5	14 oz		Cyprodinil	9	16.8 abc	20.0
			Fludioxonil	12		
Iprodione 4	1 pt		Iprodione	2	14.0 abc	33.3
Pristine 38	23 oz		Boscalid	7	13.0 bc	38.1
			Pyraclostrobin	11		
Luna Tranquility 45	18 fl oz		Fluopyram	7	9.8 c	53.3
			Pyrimethalin	9		
Captan 80	2.5 lb		Captan	M4	7.8 c	62.9
Treatment means followed by the same letter are not statistically different according to the Bartlett's X2 test at P = 0.03						

The researchers described the Botrytis disease pressure as low. There was virtually no disease pressure until the end of the trial. Disease was first observed on July 9, 2016 (10 days after the last application). The treatments were therefore assumed to have been applied preventatively.

No phytotoxicity was reported.

c. Discussion

In this study, Oso applied at 12 fl oz/acre provided 52.4% control of Botrytis fruit rot on raspberries.

Oxidate was the only OMRI-listed product evaluated in this trial. Oso provided statistically *superior* control of Botrytis fruit rot on raspberries compared to Oxidate.

Oxidate was *ineffective* in this trial. More Botrytis fruit rot was observed in the Oxidate treatment than in the untreated control.

Two formulations of polyoxin D zinc salt were evaluated in this trial. Oso is the 5% suspension concentrate formulation. PH~D is the 11.3% water dispersible granular formulation. *Oso provided noticeably superior Botrytis fruit rot control compared to PH~D (52.4% compared to 5.7%).*

Raspberries #3: Trial No. KAK-2017-Rasp-MI

a. Design

Raspberries / Botrytis Fruit Rot (*Botrytis cinerea*) #3: Trial No. KAK-2017-Rasp-MI: Design				
Title:	Evaluation of fungicides for control of powdery mildew and Botrytis in tunnel-grown raspberries, 2017			
Author and affiliation:	A, M. C. Schilder, J. M. Gillett, and R. W. Sysak Michigan State University			
Publication:	PDMR (planned for fall 2018 publication)			
Location:	Haygrove tunnel in Lawton, MI			
Crop:	Raspberry (*Rubus idaeus*)			
Disease name:	Botrytis fruit rot			
Pathogen:	*Botrytis cinerea*			
Test plot design:	Randomized complete block			
Number of replicates:	4			
Application equipment:	Hand-held Smith Contractor Sprayer (29 psi)			
Spray volume:	50 gallons/acre on 05/16/2017 75 gallons/acre for the remainder of the season			
Application type(s):	Preventative			
Number of applications:	5			
Chronology:	Application Dates	Application Interval (days)	Growth Stage	Disease Assessment Dates
	05/16/2017		Green up	07/15/2017
	05/30/2017	14	40% bloom	
	06/13/2017	14	Bloom and green fruit	
	06/20/2017	7	Green fruit	
	06/29/2017	9	Red fruit	
Disease assessment methodology:	Incidence: % of leaves or fruit with disease. Severity: % area symptomatic on diseased plant parts only. Overall severity: (Incidence x Severity) / 100.			

b. Results

Raspberries / Botrytis Fruit Rot (*Botrytis cinerea*) #3: Trial No. KAK-2017-Rasp-MI: Results						
Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	Field Incidence on Fruit (%)	
					Measured	Percent Control
Untreated control			Not Applicable		53.3 a	
Oso	6.5 fl oz	25	Polyoxin D zinc salt	19	10.0 de	81
Oso	13 fl oz	50	Polyoxin D zinc salt	19	0.0 f	100
Botector	10 oz		*Aureobasidium pullulans* strains DSM 14940 and DSM 14941	NC	21.1 b	60
Double Nickel LC	3 qt		*Bacillus amyloliquefaciens* str. D747	44	16.7 bc	69
Cueva	2 gal		Copper octanoate	M1	14.5 cd	73
Fracture	35 fl oz		Banda de Lupinus albus doce (BLAD)	M12	14.5 cd	73
Kenja 400SC	13.5 fl oz		Isofetamid	7	8.9 e	83
Kinetic	3 fl oz/100 gal		Non-ionic surfactant	NA		
Kenja 400SC	15.5 fl oz		Isofetamid	7	0.0 f	100
Kinetic	3 fl oz/100 gal		Non-ionic surfactant	NA		
Prolivo	4 fl oz		Pyriofenone	U8	8.9 e	83
Kinetic	3 fl oz/100 gal		Non-ionic surfactant	NA		
Prolivo	5 fl oz		Pyriofenone	U8	0.0 f	100
Kinetic	3 fl oz/100 gal		Non-ionic surfactant	NA		
Switch 62.5WG	14 oz		Cyprodinil	9	0.0 f	100
			Fludioxonil	12		
Kinetic	3 fl oz/100 gal		Non-ionic surfactant	NA		
Treatment means followed by the same letter are not statistically different according to the Fisher's Protected LSD test at $P \leq 0.05$.						

The researcher described the Botrytis disease pressure as high, especially for a field rating of Botrytis fruit rot.

No phytotoxicity was observed.

c. Discussion

In this trial, Oso applied at 6.5 fl oz/acre and 13 fl oz/acre provided 81% and 100% control of Botrytis fruit rot, respectively.

OMRI-listed products evaluated in this trial were Botector, Double Nickel LC and Cueva.

Based upon this trial, Oso applied at both 6.5 fl oz/acre and at 13 fl oz/acre provided *superior* control of Botrytis fruit rot on raspberries compared to Botector, Double Nickel and Cueva.

Fracture is a biopesticide, but based upon information on the Internet, is not OMRI-listed.

CROP GROUP 13: BERRIES AND SMALL FRUITS: CANEBERRIES / Powdery Mildew (*Podosphaera aphanis*)

Raspberries #1: Trial No. KAK-2017-Rasp-MI

a. Design

Raspberries / Powdery Mildew (*Podosphaera aphanis* var. *aphanis*) #1: Trial No. KAK-2017-Rasp-MI: Design				
Title:	Evaluation of fungicides for control of powdery mildew and Botrytis in tunnel-grown raspberries, 2017			
Author and affiliation:	A. M. C. Schilder, J. M. Gillett, and R. W. Sysak Michigan State University			
Publication:	PDMR (planned for fall 2018 publication)			
Location:	Haygrove tunnel in Lawton, MI			
Crop:	Raspberry (*Rubus idaeus*)			
Disease name:	Powdery mildew			
Pathogen:	*Podosphaera aphanis* var. *aphanis*			
Test plot design:	Randomized complete block			
Number of replicates:	4			
Application equipment:	Hand-held Smith Contractor Sprayer (29 psi)			
Spray volume:	50 gallons/acre on 05/16/2017 75 gallons/acre for the remainder of the season			
Application type(s):	Preventative			
Number of applications:	5			
Chronology:	Application Dates	Application Interval (days)	Growth Stage	Disease Assessment Dates
	05/16/2017		Green up	07/15/2017
	05/30/2017	14	40% bloom	
	06/13/2017	14	Bloom and green fruit	
	06/20/2017	7	Green fruit	
	06/29/2017	9	Red fruit	
Disease assessment methodology:	Incidence: % of leaves or clusters with disease. Severity: % area symptomatic on diseased plant parts only. Overall severity: (Incidence x Severity) / 100.			

b. Results

Raspberries / Powdery Mildew (*Podosphaera aphanis* var. *aphanis*) #1: Trial No. KAK-2017-Rasp-MI: Results								
Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	Leaves (7/15/2017)			
					Incidence (%)	Severity (%)	Overall Severity (%)	Control (%)
Untreated control			Not Applicable		57.3 a	12.2 a	7.0 a	
Oso	6.5 fl oz	25	Polyoxin D zinc salt	19	13.3 ef	1.5 e	0.2 e	97
Oso	13 fl oz	50	Polyoxin D zinc salt	19	0.0 g	0.0 f	0.0 e	100
Cueva	2 gal		Copper octanoate	M1	41.3 b	7.3 b	3.0 b	57
Double Nickel LC	3 qt		*Bacillus amyloliquefaciens* str. D747	44	38.7 bc	7.8 b	3.0 b	57
Botector	10 oz		*Aureobasidium pullulans* strains DSM 14940 and DSM 14941	NC	33.3 cd	5.5 c	1.8 c	74
Fracture	35 fl oz		Banda de Lupinus albus doce (BLAD)	M12	28.0 d	3.4 d	1.0 d	86
Kenja 400SC	13.5 fl oz		Isofetamid	7	18.7 e	2.0 e	0.4 e	94
Kinetic	3 fl oz/100 gal		Non-ionic surfactant	NA				
Prolivo	4 fl oz		Pyriofenone	U8	8.0 f	0.7 ef	0.1 e	99
Kinetic	3 fl oz/100 gal		Non-ionic surfactant	NA				
Kenja 400SC	15.5 fl oz		Isofetamid	7	0.0 g	0.0 f	0.0 e	100
Kinetic	3 fl oz/100 gal		Non-ionic surfactant	NA				
Prolivo	5 fl oz		Pyriofenone	U8	0.0 g	0.0 f	0.0 e	100
Kinetic	3 fl oz/100 gal		Non-ionic surfactant	NA				
Switch 62.5WG	14 oz		Cyprodinil	9	0.0 g	0.0 f	0.0 e	100
			Fludioxonil	12				
Kinetic	3 fl oz/100 gal		Non-ionic surfactant	NA				
Treatment means followed by the same letter are not statistically different according to the Fisher's Protected LSD test at $P \leq 0.05$.								

The researchers reported that the powdery mildew disease pressure was moderate on leaves and not evident on fruit.

No phytotoxicity was observed.

c. Discussion

Based upon this trial, Oso applied at 6.5 fl oz/acre and 13 fl oz/acre provided 97% and 100% control, respectively, of powdery mildew on raspberry leaves.

OMRI-listed products evaluated in this trial included Cueva, Double Nickel LC, and Botector. Oso provided statistically *superior* control of powdery mildew on raspberry leaves compared to that provided by Cueva (57% control), Double Nickel LC (also 57% control), and Botector (74% control).

Fracture is a biopesticide, but based upon information on the Internet, is not OMRI-listed.

CROP GROUP 13: CRANBERRIES / Cottonball (*Monilinia oxycocci*)

#3: Trial No. 11:SMF011(2016; WI)

a. Design

Cranberries / Cottonball (*Monilinia oxycocci*) #3: Trial No. 11:SMF011(2016; WI): Design		
Title:	Evaluation of fungicides for control of cranberry cottonball in Wisconsin, 2016	
Authors and affiliation:	P. McManus and R.S. Perry University of Wisconsin	
Publication:	PDMR 11:SMF011	
Location:	Near City Point, WI	Near Warrens, WI
Crop:	Cranberry (cultivar Ben Lear)	Cranberry (cultivar Ben Lear)
Disease name:	Cottonball	
Pathogen:	*Monilinia oxycocci*	
Test plot design:	Randomized compete block	
Number of replicates:	5	
Application equipment:	CO_2 backpack sprayer (31 psi)	
Spray volume:	28.4 gal/acre	
Number of applications:	2	
Application interval:	8 days	12 days
Application dates:	07/07/2016 (10% bloom) 07/15/2016 (50% bloom)	07/06/2016 (10% bloom) 07/18/2016 (50% bloom)
Disease assessment date(s):	09/22/2016	09/13/2016
Yield calculation:	One barrel = 100 pounds (industry standard)	

b. Results

Cranberries / Cottonball (*Monilinia oxycocci*) #3: Trial No. 11:SMF011(2016; WI): Incidence on Fruit								
Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	% Cottonball Incidence City Point, WI		% Cottonball Incidence Warrens, WI	
					Measured	Percent Control	Measured	Percent Control
Untreated control			Not Applicable		11.9 a		10.7 a	
Oso 5SC	6.5 fl oz	25	Polyoxin D zinc salt	19	4.0 cde	66	5.8 bcd	46
X77	0.25% (v/v)	NA	Non-ionic spreader	NA				
Regalia 5EC	2 pt		*Reynoutria sachalinensis* extract	P5	4.0 cde	66	5.2 cd	51
Kenja 400SC	15.5 fl oz		Isofetamid	7	6.1 bc	49	7.1 abc	34
Treatment means followed by the same letter are not statistically different according to Fisher's Protected LSD test at P = 0.05.								

Cranberries / Cottonball (*Monilinia oxycocci)* #3: Trial No. 11:SMF011(2016; WI): Yield								
Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	Yield (Barrels/Acre) City Point, WI		Yield (Barrels/Acre) Warrens, WI	
					Measured	Percent Increase	Measured	Percent Increase
Untreated control			Not Applicable		265.3 b		318.3 b	
Oso 5SC	6.5 fl oz	25	Polyoxin D zinc salt	19	310.4 a	17.0	339.1 ab	6.53
X77	0.25% (v/v)	NA	Non-ionic spreader	NA				
Regalia 5EC	2 pt		*Reynoutria sachalinensis* extract	P5	313.6 a	18.2	353.8 ab	11.2
Kenja 400SC	15.5 fl oz		Isofetamid	7	300.9 ab	13.4	335.6 ab	5.4
Treatment means followed by the same letter are not statistically different according to Fisher's Protected LSD test at P = 0.05.								

The date of first observation of cottonball symptoms was not reported. Therefore, the treatments are assumed to have been preventative.

The researchers described the cottonball disease pressure as low at both sites.

No phytotoxicity was observed.

c. Discussion

In this trial report, Oso applied at 6.5 fl oz/acre tank-mixed with X77 (a non-ionic spreader) applied at 0.25% (v/v) at *two different trial sites* provided:

- 66% and 46% control, respectively, of cottonball on cranberries; and
- 17.0% and 6.53% increased cranberry yield, respectively.

Regalia was the only OMRI-listed product evaluated in this trial. In this trial, Oso and Regalia provided statistically *equivalent*:

- Control of cottonball on cranberries; and
- Increased yields.

CROP GROUP 13: CRANBERRIES / Cranberry Fruit Rot Complex (*Coleophoma empetri*, *Colletotrichum acutatum*, *Colletotrichum gloeosporioides*, *Phyllosticta vaccinii*, and *Physalospora vaccinii*, etc.)

#3: Trial No. 11:SMF012 (2016; WI)

a. Design

Cranberries / Fruit Rot Complex (*Coleophoma empetri*, etc.) #3: Trial No. 11:SMF012 (2016; WI): Design					
Title:	Evaluation of fungicides for control of cranberry fruit rot in Wisconsin, 2016				
Authors and affiliation:	P. McManus and R.S. Perry University of Wisconsin				
Publication:	PDMR 11:SMF012				
Location; Crop; Crop age	Oakdale; cranberry 'Stevens'; 30 years old				
	Valley Junction; cranberry 'Stevens'; 3 years old				
	Warrens; cranberry 'Mullica Queen'; 3 year old 3				
	Mather; cranberry 'GHI'; 3 years old				
	Tomah; cranberry 'Scarlet Knight'; 2 years old				
Disease name:	Cranberry fruit rot complex				
Pathogen:	Ripe rot: *Coleophoma empetri* Bitter rot: *Colletotrichum* spp. Viscid rot: *Phomopsis vaccinii* Early rot: *Phyllosticta vaccinii* Blotch rot: *Physalospora vaccinii*				
Test plot design:	Randomized complete block				
Number of replicates:	5				
Application equipment:	CO_2 backpack sprayer (31 psi)				
Spray volume:	28.4 gal/acre				
Number of applications:	2				
Chronology:	Site	App. Date	Growth Stage	App. Interval	Disease Assessment
	Oakdale	06/30/2016	Full bloom	11 days	09/29/2016
		07/11/2016	Late bloom/early fruit set		
	Valley Junction	06/30/2016	Full bloom	11 days	09/27/2016
		07/11/2016	Late bloom/early fruit set		
	Warrens	06/24/2016	Full bloom	14 days	09/08/2016
		07/08/2016	Late bloom/early fruit set		
	Mather	06/30/2016	Full bloom	11 days	09/27/2016
		07/11/2016	Late bloom/early fruit set		
	Tomah	06/24/2016	Full bloom	14 days	09/06/2016
		07/08/2016	Late bloom/early fruit set		
Disease assessment methodology:	Soft, discolored fruit				

b. Results

Cranberries / Fruit Rot Complex (*Coleophoma empetri*, etc.) #3a: Trial No. 11:SMF012 (2016; WI): Results: Oakdale								
Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	Fruit Rot Incidence (%)		Yield (Barrels/Acre)	
					Measured	Percent Control	Measured	Percent Increase
Untreated control			Not Applicable		31.3 a		322 ab	
Oso 5SC	6.5 fl oz	25	Polyoxin D zinc salt	19	6.9 c	78.0	295 ab	-8.4
X77	0.25% (v/v)	NA	Non-ionic spreader	NA				
Regalia 5EC	2 pt		*Reynoutria sachalinensis* extract	P5	7.2 c	77.0	294 ab	-8.7
Kenja 400SC	15.5 fl oz		Isofetamid	7	24.6 b	21.4	343 a	6.5
Treatment means followed by the same letter are not statistically different according to the Fisher's Protected LSD test at P = 0.05.								

Cranberries / Fruit Rot Complex (*Coleophoma empetri*, etc.) #3b: Trial No. 11:SMF012 (2016; WI): Results: Valley Junction								
Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	Fruit Rot Incidence (%)		Yield (Barrels/Acre)	
					Measured	Percent Control	Measured	Percent Increase
Untreated control			Not Applicable		35.2 a		141 d	
Oso 5SC	6.5 fl oz	25	Polyoxin D zinc salt	19	4.5 b	87.2	238 a-d	68.8
X77	0.25% (v/v)	NA	Non-ionic spreader	NA				
Regalia 5EC	2 pt		*Reynoutria sachalinensis* extract	P5	22.8 a	35.2	198 a-d	40.4
Kenja 400SC	15.5 fl oz		Isofetamid	7	35.9 a	-2.0	156 cd	10.6
Treatment means followed by the same letter are not statistically different according to the Fisher's Protected LSD test at P = 0.05.								

Cranberries / Fruit Rot Complex (*Coleophoma empetri*, etc.) #3c: Trial No. 11:SMF012 (2016; WI): Results: Warrens								
Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	Fruit Rot Incidence (%)		Yield (Barrels/Acre)	
					Measured	Percent Control	Measured	Percent Increase
Untreated control			Not Applicable		40.5 a		443 a	
Oso 5SC	6.5 fl oz	25	Polyoxin D zinc salt	19	17.8 c	56.0	359 ab	-19.0
X77	0.25% (v/v)	NA	Non-ionic spreader	NA				
Regalia 5EC	2 pt		*Reynoutria sachalinensis* extract	P5	20.8 c	48.6	348 ab	-21.4
Kenja 400SC	15.5 fl oz		Isofetamid	7	31.3 b	22.7	394 ab	-11.1
Treatment means followed by the same letter are not statistically different according to the Fisher's Protected LSD test at P = 0.05.								

Cranberries / Fruit Rot Complex (*Coleophoma empetri*, etc.) #3d: Trial No. 11:SMF012 (2016; WI): Results: Mather								
Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	Fruit Rot Incidence (%)		Yield (Barrels/Acre)	
					Measured	Percent Control	Measured	Percent Increase
Untreated control			Not Applicable		61.6 a		91 d	
Oso 5SC	6.5 fl oz	25	Polyoxin D zinc salt	19	44.3 ab	28.1	130 a-d	42.9
X77	0.25% (v/v)	NA	Non-ionic spreader	NA				
Regalia 5EC	2 pt		*Reynoutria sachalinensis* extract	P5	44.5 ab	27.8	138 a-d	51.6
Kenja 400SC	15.5 fl oz		Isofetamid	7	63.8 a	-3.6	91 d	0.0
Treatment means followed by the same letter are not statistically different according to the Fisher's Protected LSD test at P = 0.05.								

Cranberries / Fruit Rot Complex (*Coleophoma empetri*, etc.) #3e: Trial No. 11:SMF012 (2016; WI): Results: Tomah								
Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	Fruit Rot Incidence (%)		Yield (Barrels/Acre)	
					Measured	Percent Control	Measured	Percent Increase
Untreated control			Not Applicable		33.3 a		374 bc	
Oso 5SC	6.5 fl oz	25	Polyoxin D zinc salt	19	19.1 c	42.6	317 b-e	-15.2
X77	0.25% (v/v)	NA	Non-ionic spreader	NA				
Regalia 5EC	2 pt		*Reynoutria sachalinensis* extract	P5	23.4 bc	29.7	305 b-e	-18.4
Kenja 400SC	15.5 fl oz		Isofetamid	7	33.8 a	-1.5	276 de	-26.2
Treatment means followed by the same letter are not statistically different according to the Fisher's Protected LSD test at P = 0.05.								

The diseases assessment date was after the last application treatment. Therefore, the treatments were assumed to be preventative.

The researchers described the cranberry fruit rot disease pressure at all sites to be high.

No phytotoxicity was observed on fruit or foliage.

c. Discussion

In this trial report which included *5 different trial sites*, Oso applied at 6.5 fl oz acre tank-mixed with X77 (a non-ionic spreader) applied at 0.25% (v/v) provided:

- 78.0%, 87.2%, 56.0%, 28.1%, and 42.6% (mean 58.4%) control of cranberry fruit complex; and
- -8.4%, 68.8%, -19.0%, 42.9%, and -15.2% (mean 13.8%) increased cranberry yield.

Regalia 5EC was the only OMRI-listed product that was also evaluated in this trial.

- For 4 of the 5 trials sites, Oso provided statistically *equivalent* control of cranberry fruit rot complex compared to Regalia;
- For the Valley Junction site, Oso provided statistically *superior* control of cranberry fruit rot complex compared to Regalia; and
- For all 5 trial sites, Oso provided statistically *equivalent* increased yield of cranberries.

CROP GROUP 13: BERRIES AND SMALL FRUITS: GRAPES / Bunch Rot (*Botrytis cinerea*)

#6: Trial No. 9:SMF001

a. Design

Grapes / Bunch Rot (*Botrytis cinerea*) #6: Trial No. 9:SMF001: Design				
Title:	Management of grape Botrytis bunch rot with experimental, organic and conventional fungicides, 2014			
Author and affiliation:	T. T. Nguyen, N. S. Morris, and W. D. Gubler University of California, Davis, CA			
Publication:	PDMR 9:SMF001			
Location:	Napa County, CA			
Crop:	Grape (*Vitis* 'Chardonnay')			
Disease name:	Bunch rot			
Pathogen:	*Botrytis cinerea*			
Test plot design:	Randomized complete block			
Number of replicates:	4			
Application equipment:	Nifty-Fifty pump tank/engine spray system			
Spray volume:	200 gal/acre			
Application type(s):	Preventative			
Number of applications:	3			
Chronology:	Application Dates	Application Interval (Days)	Growth Stage	Disease Assessment Dates
	05/08/2014		Bloom	10/06/2014
	06/12/2014	35	Pre-close	
	07/17/2014	35	Veraison	

b. Results

Grapes / Bunch Rot (*Botrytis cinerea*) #6: Trial No. 9:SMF001: Results								
Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	Incidence (%)		Severity (%)	
					Measured	Percent Control	Measured	Percent Control
Untreated control			Not Applicable		22.8 a		4.4 a	
Tavano 5%SC	6.5 fl oz	25	Polyoxin D zinc salt	19	4.0 cd	82.5	1.5 bc	59.1
Isofetamid	20 fl oz		Isofetamid	7	2.0 cd	91.2	0.0 c	100
Elevate	16 fl oz		Fenhexamid	17	4.0 cd	82.5	0.2 c	95.5
Double Nickel LC	2 qt		*Bacillus amyloliquefaciens* str. D747	44	1.0 d	95.6	0.3 bc	93.2
Double Nickel 55WDG	20 oz		*Bacillus amyloliquefaciens* str. D747	44	5.0 cd	78.1	1.3 bc	70.5
Treatment means followed by the same letter are not statistically different according to the Student's t test at α = 0.05.								

No phytotoxicity was reported.

c. Discussion

In this trial, Tavano (containing 5% polyoxin D zinc salt) applied at 6.5 fl oz/acre provided:

- 82.5% control of grape bunch rot incidence; and
- 59.1% control of grape bunch rot severity.

Double Nickel LC and Double Nickel 55WDG are OMRI-listed products evaluated in this trial. Tavano provided relative to these products:

- Statistically *equivalent* control of bunch rot incidence; and
- Statistically *equivalent* control of bunch rot severity.

CROP GROUP 13: BERRIES AND SMALL FRUITS: GRAPES / Powdery Mildew (*Erysiphe necator*)

#6: Trial No. KAK-2016-Grape-MI

a. Design

<table>
<tr><th colspan="6">Grapes / Powdery Mildew (Erysiphe necator) #6:
Trial No. KAK-2016-Grape-MI: Design</th></tr>
<tr><td>Title:</td><td colspan="5">Evaluation of fungicides for control of foliar and fruit diseases of juice grapes, 2016</td></tr>
<tr><td>Author and affiliation:</td><td colspan="5">A. M. Schilder, J. M. Gillett, and R. W. Sysak
Michigan State University</td></tr>
<tr><td>Publication:</td><td colspan="5">PDMR (planned for fall 2018 publication)</td></tr>
<tr><td>Location:</td><td colspan="5">Fennville, MI</td></tr>
<tr><td>Crop:</td><td colspan="5">Grape (Vitis labrusca “Niagara’)</td></tr>
<tr><td>Disease name:</td><td colspan="5">Powdery mildew</td></tr>
<tr><td>Pathogen:</td><td colspan="5">Erysiphe necator</td></tr>
<tr><td>Test plot design:</td><td colspan="5">Randomized complete block</td></tr>
<tr><td>Number of replicates:</td><td colspan="5">4</td></tr>
<tr><td>Application equipment:</td><td colspan="5">Research sprayer with 5-foot spray boom</td></tr>
<tr><td>Spray volume:</td><td colspan="5">50 gal/acre (May 8, 2016 to July 1, 2016)
75 gal/acre (remainder of the season)</td></tr>
<tr><td>Application type(s):</td><td colspan="5">Preventative</td></tr>
<tr><td>Number of applications:</td><td colspan="5">7 (Oso at 10-day to 16-day intervals)</td></tr>
<tr><td rowspan="9">Chronology:</td><td colspan="3">Application</td><td rowspan="2">Growth Stage</td><td rowspan="2">Disease Assessment Date</td></tr>
<tr><td>No.</td><td>Date</td><td>Interval</td></tr>
<tr><td>1</td><td>05/23/2016</td><td></td><td>3-5 inch shoot</td><td>09/10/2016</td></tr>
<tr><td>2</td><td>06/08/2016</td><td>16 days</td><td>10-16 inch shoot</td><td></td></tr>
<tr><td>3</td><td>06/21/2016</td><td>13 days</td><td>Bloom</td><td></td></tr>
<tr><td>4</td><td>07/01/2016</td><td>10 days</td><td>Pea-size fruit</td><td></td></tr>
<tr><td>5</td><td>07/12/2016</td><td>11 days</td><td>2nd post-bloom</td><td></td></tr>
<tr><td>6</td><td>07/27/2016</td><td>15 days</td><td>3rd post bloom</td><td></td></tr>
<tr><td>7</td><td>08/03/2016 [A]</td><td>7 days</td><td></td><td></td></tr>
<tr><td>8</td><td>08/10/2016</td><td>7 days</td><td>4th post-bloom</td><td></td></tr>
<tr><td>Disease assessment methodology:</td><td colspan="5">• 25 randomly selected leaves and clusters from the center vine in each plot were visually rated.
• Incidence = Percent leaves or clusters with disease.
• Severity = Percent area symptomatic on diseased plants only.
• Overall Severity = (Incidence x Severity) / 100.</td></tr>
<tr><td colspan="6">A. 08/03/2016 application was limited to selected treatment programs that included Ridomil Gold SL to control downy mildew.</td></tr>
</table>

Grapes / Powdery Mildew (*Erysiphe necator*) #6: Trial No. KAK-2016-Grape-MI: Results: Leaves (9/10/2016)									
Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	App. Code	Incidence on Leaves (%)	Severity on Leaves (%)	Overall Severity on Leaves (%)	Percent Control on Leaves
Untreated control			Not Applicable			63.0 a	38.4 a	24.23 a	
Oso 5%SC	6.5 fl oz	25	Polyoxin D zinc salt	19	1,2,3,4, 5,6,8	30.0 b	8.2 b	2.45 bc	90
Oso 5%SC	13 fl oz	50	Polyoxin D zinc salt	19	1,2,3,4, 5,6,8	5.0 de	1.5 de	0.10 d	99
Ranman	2.75 fl oz		Cyazofamid	21	1,2,3,4, 5,6,8	1.0 e	0.5 ef	0.02 d	99
Silwet L-77	2 fl oz		Nonionic surfactant	NA					
Manzate Pro-Stick	3 lb		Cymoxanil	27	1, 2	0.0 e	0.0 f	0.0 d	100
Pristine 38WG	12.5 oz		Boscalid	7	3,4,6,8				
			Pyraclostrobin	11					
Super Spread 90	0.125%		Non-ionic surfactant	NA					
Ziram 76DF	3 lb		Ziram	M3	5				
Ridomil Gold			Mefenoxam	4	7,8				
Treatment means followed by the same letter are not statistically different according to the Fischer's Protected SD test at P ≤ 0.05.									

Grapes / Powdery Mildew (*Erysiphe necator*) #6: Trial No. KAK-2016-Grape-MI: Results: Cluster (9/10/2016)									
Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	App. Code	Incidence on Cluster (%)	Severity on Cluster (%)	Overall Severity on Cluster (%)	Percent Control on Cluster
Untreated control			Not Applicable			58.0 a	15.8 a	9.20 a	
Oso 5%SC	6.5 fl oz	25	Polyoxin D zinc salt	19	1,2,3,4, 5,6,8	25.0 b	4.3 b	1.11 b	88
Oso 5%SC	13 fl oz	50	Polyoxin D zinc salt	19	1,2,3,4, 5,6,8	5.0 ef	1.8 cde	0.13 c-f	99
Ranman	2.75 fl oz		Cyazofamid	21	1,2,3,4, 5,6,8	1.0 f	0.5 de	0.02 ef	99
Silwet L-77	2 fl oz		Nonionic surfactant	NA					
Manzate Pro-Stick	3 lb		Cymoxanil	27	1, 2	0.0 f	0.0 e	0.0 f	100
Pristine 38WG	12.5 oz		Boscalid	7	3,4,6,8				
			Pyraclostrobin	11					
Super Spread 90	0.125%		Non-ionic surfactant	NA					
Ziram 76DF	3 lb		Ziram	M3	5				
Ridomil Gold			Mefenoxam	4	7,8				
Treatment means followed by the same letter are not statistically different according to the Fischer's Protected SD test at P ≤ 0.05.									

The first assessments were performed after the last treatment. Therefore, all treatments are assumed to be preventative.

The researchers reported the powdery mildew disease pressure to be moderate on leaves and low on clusters.

No phytotoxicity was observed.

c. Discussion

In this trial, Oso applied at 6.5 fl oz/acre and 13 fl oz/acre provided:

- 90% and 99% control, respectively, of powdery mildew on grape leaves; and
- 88% and 99% control, respectively, of powdery mildew on grape clusters.

No OMRI-listed products were evaluated in this trial.

#7: Trial No. KAK-2017-Grape-MI

a. Design

<table>
<tr><th colspan="6">Grapes / Powdery Mildew (Erysiphe necator) #7:
Trial No. KAK-2017-Grape-MI: Design</th></tr>
<tr><td>Title:</td><td colspan="5">Evaluation of fungicides for control of foliar diseases of juice grapes, 2017</td></tr>
<tr><td>Author and affiliation:</td><td colspan="5">A. M.C. Schilder, J. M. Gillett, and R. W. Sysak
Michigan State University</td></tr>
<tr><td>Publication:</td><td colspan="5">PDMR (planned for fall 2018 publication)</td></tr>
<tr><td>Location:</td><td colspan="5">Fennville, MI</td></tr>
<tr><td>Crop:</td><td colspan="5">Grape (‘Niagara’)</td></tr>
<tr><td>Disease name:</td><td colspan="5">Powdery mildew</td></tr>
<tr><td>Pathogen:</td><td colspan="5">Erysiphe necator</td></tr>
<tr><td>Test plot design:</td><td colspan="5">Randomized complete block</td></tr>
<tr><td>Number of replicates:</td><td colspan="5">4</td></tr>
<tr><td>Application equipment:</td><td colspan="5">Research sprayer with 5-foot boom</td></tr>
<tr><td>Spray volume:</td><td colspan="5">40 gallons/acre (first 3 applications)
50 gallons/acre (later season applications)</td></tr>
<tr><td>Application type(s):</td><td colspan="5">Preventative</td></tr>
<tr><td>Number of applications:</td><td colspan="5">7</td></tr>
<tr><td rowspan="8">Chronology:</td><td>App. Code</td><td>Application Dates</td><td>App. Interval (Days)</td><td>Growth Stage</td><td>Disease Assessment Dates</td></tr>
<tr><td>A</td><td>05/16/2017</td><td></td><td>3-5 inch shoots</td><td>09/18/2017</td></tr>
<tr><td>B</td><td>05/30/2017</td><td>14</td><td>7-17 inch shoots</td><td></td></tr>
<tr><td>C</td><td>06/10/2017</td><td>11</td><td>Pre-bloom/bloom</td><td></td></tr>
<tr><td>D</td><td>06/21/2017</td><td>11</td><td>1st post-bloom; bb-size fruit</td><td></td></tr>
<tr><td>E</td><td>07/11/2017</td><td>19</td><td>2nd post-bloom; pea-size fruit</td><td></td></tr>
<tr><td>F</td><td>07/25/2017</td><td>14</td><td>3rd post-bloom; pre-bunch closure</td><td></td></tr>
<tr><td>G</td><td>08/14/2017</td><td>20</td><td>4th post-bloom; bunch closure</td><td></td></tr>
<tr><td>Disease assessment methodology:</td><td colspan="5">Incidence: % of leaves or clusters with disease.
Severity: % area symptomatic on diseased plant parts only.
Overall severity: (Incidence x Severity) / 100.</td></tr>
</table>

b. Results

Grapes / Powdery Mildew (*Erysiphe necator*) #7: Trial No. KAK-2017-Grape-MI: Results: Leaves									
Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	App Code	Incidence (%)	Severity (%)	Overall Severity (%)	Control (%)
Untreated control			Not Applicable			79.0 a	44.0 a	34.9 a	
Oso	13.0 fl oz	50	Polyoxin D zinc salt	19	ABCDEFG	28.0 d	4.4 c	1.2 b	97
Lifegard WG	4.5 oz/ 100 gal		*Bacillus mycoides* isolate J		ABCDEFG	36.0 b	5.5 c	2.0 b	94
Stargus	64 fl oz		*Bacillus amyloliquefaciencs* strain F727		ABCDEFG	42.0 b	6.9 b	2.9 b	96
Intuity 4SC	6 fl oz		Mandestrobin	11	ABCDEFG	39.0 b	4.9 c	1.9 b	95
Super Spread 90	0.125% (v/v)		Non-ionic surfactant	NA	ABCDEFG				
Treatment means followed by the same letter are not statistically different according to the Fischer's Protected LSD test at P ≤ 0.05.									

Grapes / Powdery Mildew (*Erysiphe necator*) #7: Trial No. KAK-2017-Grape-MI: Results: Clusters									
Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	App Code	Incidence (%)	Severity (%)	Overall Severity (%)	Control (%)
Untreated control			Not Applicable			85.0 a	43.0 a	36.6 a	
Oso	13.0 fl oz	50	Polyoxin D zinc salt	19	ABCDEFG	8.0 e	2.5 cd	0.3 d	99
Lifegard WG	4.5 oz/ 100 gal		*Bacillus mycoides* isolate J	44	ABCDEFG	25.0 bc	4.2 b	1.1 b	97
Stargus	64 fl oz		*Bacillus amyloliquefaciencs* strain F727	44	ABCDEFG	29.0 b	3.8 bc	1.1 b	97
Intuity 4SC	6 fl oz		Mandestrobin	11	ABCDEFG	27.0 bc	3.9 bc	1.1 b	97
Super Spread 90	0.125% (v/v)		Non-ionic surfactant	NA	ABCDEFG				
Treatment means followed by the same letter are not statistically different according to the Fischer's Protected LSD test at P ≤ 0.05.									

The researchers described the powdery mildew disease pressure as moderate.

No phytotoxicity was observed.

c. Discussion

In this trial, Oso applied at 13 fl oz/acre provided 97% and 99% control of powdery mildew on grape leaves and clusters, respectively.

Lifegard WG and Stargus are OMRI-listed products evaluated in this trial. Oso provided:

- Numerically *superior* control of powdery mildew on grape leaves compared to Lifegard WG and compared to Stargus.
- Statistically *superior* control of powdery mildew on grape clusters compared to Lifegard WG and compared to Stargus.

#8: Trial No. KAK-2017-Grape-PA

a. Design

<table>
<tr><th colspan="7">Grapes / Powdery Mildew (Erysiphe necator) #8:
Trial No. KAK-2017-Grape-PA: Design</th></tr>
<tr><td>Title:</td><td colspan="6">Evaluation of OSO 5% and other alternative fungicides on Vitis labrusca ‘Concord’ grapes, 2017.</td></tr>
<tr><td>Author and affiliation:</td><td colspan="6">Bryan Hed
Lake Erie Regional Grape Research and Extension Center
Penn State University</td></tr>
<tr><td>Publication:</td><td colspan="6">PDMR (submitted)</td></tr>
<tr><td>Location:</td><td colspan="6">North East, PA</td></tr>
<tr><td>Crop:</td><td colspan="6">Grapes (Concord)</td></tr>
<tr><td>Disease name:</td><td colspan="6">Powdery mildew</td></tr>
<tr><td>Pathogen:</td><td colspan="6">Podosphaera xanthii</td></tr>
<tr><td>Test plot design:</td><td colspan="6">Randomized complete block</td></tr>
<tr><td>Number of replicates:</td><td colspan="6">4</td></tr>
<tr><td>Application equipment:</td><td colspan="6">Friend covered-boom plot sprayer</td></tr>
<tr><td>Spray volume:</td><td colspan="6">50 gallons/acre (100 psi)</td></tr>
<tr><td>Application type(s):</td><td colspan="6">Preventative</td></tr>
<tr><td>Number of applications:</td><td colspan="6">7</td></tr>
<tr><td rowspan="11">Chronology:</td><td colspan="3">Application</td><td rowspan="2">Days After First Application</td><td rowspan="2">Growth Stage</td><td rowspan="2">Disease Assessment Dates</td></tr>
<tr><td>Code</td><td>Dates</td><td>Interval (Days)</td></tr>
<tr><td>A</td><td>05/10/2017</td><td></td><td>0</td><td>3-6 inch shoots</td><td></td></tr>
<tr><td>B</td><td>05/19/2017</td><td>9</td><td>9</td><td>10-12 inch shoots</td><td></td></tr>
<tr><td>C</td><td>05/28/2017</td><td>9</td><td>18</td><td>12-16 inch shoots</td><td></td></tr>
<tr><td>D</td><td>06/08/2017</td><td>11</td><td>29</td><td>Immediate pre-bloom</td><td></td></tr>
<tr><td>E</td><td>06/18/2017</td><td>10</td><td>39</td><td>1st post-bloom</td><td></td></tr>
<tr><td>F</td><td>06/28/2017</td><td>10</td><td>49</td><td>2nd post-bloom</td><td></td></tr>
<tr><td>G</td><td>07/09/2017</td><td>11</td><td>60</td><td>3rd post-bloom</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>08/03/2017 (clusters)</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>08/15/2017 (leaves)</td></tr>
<tr><td>Disease assessment methodology:</td><td colspan="6">Severity was rated using the Barratt-Horsfall scale and was converted to % area infected (0-100%) using Elanco conversion tables.</td></tr>
</table>

b. Results

Grapes / Powdery Mildew (*Erysiphe necator*) #8: Trial No. KAK-2017-Grape-PA: Results: Clusters								
Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	App Code	Incidence (%)	Severity (%)	
							Measured	% Control
Untreated control			Not Applicable			90.0 ab	6.29 a	
OSO 5%	13.0 fl oz	50	Polyoxin D zinc salt	19	ABCDEFG	42.0 d	1.03 e	84
Fracture	24.4 fl oz		Banda de Lupinus albus doce (BLAD)	BM1	ABCDEFG	90.0 a	3.91 bcd	38
Fracture	36.6 fl oz		Banda de Lupinus albus doce (BLAD)	BM1	ABCDEFG	92.0 a	3.42 bcd	46
Double Nickel	1.5 qt		*Bacillus amyloliquefaciens* str. D747	44	ABCDEFG	89.0 ab	4.78 bc	24
Double Nickel	3 qt		*Bacillus amyloliquefaciens* str. D747	44	ABCDEFG	91.0 a	5.20 ab	17
Badge X2	1.75 lb		Copper hydroxide, Copper oxychloride	M1	ABCDEFG	69.0 bc	2.57 cde	59
Lime	1.75 lb		Calcium hydroxide	NA	ABCDEFG			
Conventional standard:								
• Manzate Prostik	3 lb		Cymoxanil	27	ABCD	61.0 cd	1.64 de	74
• Ziram	4 lb		Zinc dimethyldithiocarbamate	M3	EFG			
• Quintec	4 fl oz		Quinoxyfen	13	D G			
• Vivando	10.3 fl oz		Metrafenone	U8	E			
• Toledo	4 oz		Tebuconazole	3	F			
Treatment means followed by the same letter are not statistically different according to Fisher's LDS test at P ≤ 0.05.								

Grapes / Powdery Mildew (*Erysiphe necator*) #8: Trial No. KAK-2017-Grape-PA: Results: Leaves								
Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	App Code	Incidence (%)	Severity (%)	
						Measured	Measured	Percent Control
Untreated control			Not Applicable			98.0 a	16.32 a	
OSO 5%	13.0 fl oz	50	Polyoxin D zinc salt	19	ABCDEFG	75.0 bc	3.09 bc	81
Fracture	24.4 fl oz		Banda de Lupinus albus doce (BLAD)	BM1	ABCDEFG	85.0 bc	5.74 bc	65
Fracture	36.6 fl oz		Banda de Lupinus albus doce (BLAD)	BM1	ABCDEFG	86.0 abc	8.66 abc	47
Double Nickel	1.5 qt		*Bacillus amyloliquefaciens* str. D747	44	ABCDEFG	89.0 ab	7.18 bc	56
Double Nickel	3 qt		*Bacillus amyloliquefaciens* str. D747	44	ABCDEFG	91.0 ab	9.98 ab	39
Badge X2	1.75 lb		Copper hydroxide, Copper oxychloride	M1	ABCDEFG	19.0 e	0.54 c	97
Lime	1.75 lb		Calcium hydroxide	NA	ABCDEFG			
Conventional standard:								
• Manzate Prostik	3 lb		Cymoxanil	27	ABCD	42.0 d	1.27 e	92
• Ziram	4 lb		Zinc dimethyldithiocarbamate	M3	EFG			
• Quintec	4 fl oz		Quinoxyfen	13	D G			
• Vivando	10.3 fl oz		Metrafenone	U8	E			
• Toledo	4 oz		Tebuconazole	3	F			
Treatment means followed by the same letter are not statistically different according to Fisher's LDS test at P ≤ 0.05.								

The researcher described the powdery mildew development on grape clusters and grape leaves as moderately high.

No phytotoxicity was observed.

c. Discussion

In this trial, Oso applied at 13 fl oz/acre provided:

- 84% control of powdery mildew severity on grape clusters; and
- 81% control of powdery mildew severity on grapes leaves.

OMRI-listed products evaluated in this trial included Double Nickel and Badge X2 tank-mixed with Lime. Oso provided:

- Numerically *superior* control of powdery mildew severity on grape clusters and leaves compared to Double Nickel; and
- Statistically *equivalent* control of powdery mildew severity on grape clusters and leaves compared to Badge X2 tank-mixed with lime.

CROP GROUP 13: BERRIES AND SMALL FRUITS: STRAWBERRIES / Botrytis Fruit Rot (*Botrytis cinerea*)

#4: Trial No. KAK-2016-Sberry-MD

a. Design

<table>
<tr><th colspan="6">Strawberries / Botrytis Fruit Rot (Botrytis cinerea) #4:
Trial No. KAK-2016-Sberry-MD: Design</th></tr>
<tr><td>Title:</td><td colspan="5">Evaluation of organic and conventional fungicides for the control of Botrytis fruit rot in strawberries, 2016</td></tr>
<tr><td>Author and affiliation:</td><td colspan="5">E. E. Koivunen and C. L. Swett
Univ. of Maryland</td></tr>
<tr><td>Publication:</td><td colspan="5">Submitted to Plant Disease Management Reports</td></tr>
<tr><td>Location:</td><td colspan="5">Queenstown, MD</td></tr>
<tr><td>Crop:</td><td colspan="5">Strawberry (Fragaria x ananassa ‘Chandler’)</td></tr>
<tr><td>Disease name:</td><td colspan="5">Botrytis Fruit Rot</td></tr>
<tr><td>Pathogen:</td><td colspan="5">Botrytis cinerea</td></tr>
<tr><td>Test plot design:</td><td colspan="5">Randomized complete block</td></tr>
<tr><td>Number of replicates:</td><td colspan="5">4</td></tr>
<tr><td>Application equipment:</td><td colspan="5">Twin TeeJet nozzles (60 psi)</td></tr>
<tr><td>Spray volume:</td><td colspan="5">93 gal/acre</td></tr>
<tr><td>Application type(s):</td><td colspan="5">Preventative</td></tr>
<tr><td>Number of applications:</td><td colspan="5">9</td></tr>
<tr><td rowspan="11">Chronology:</td><td rowspan="2">Application Dates</td><td rowspan="2">Application Interval</td><td colspan="3">Assessment Dates</td></tr>
<tr><td>AUDPC</td><td>Incidence</td><td>Marketable Fruit</td></tr>
<tr><td>03/30/2016</td><td></td><td>05/06/2016</td><td>05/06/2016</td><td>05/18/2016</td></tr>
<tr><td>04/06/2016</td><td>7 days</td><td>05/18/2016</td><td>05/18/2016</td><td>05/25/2016</td></tr>
<tr><td>04/13/2016</td><td>7 days</td><td>05/25/2016</td><td>05/25/2016</td><td>06/01/2016</td></tr>
<tr><td>04/20/2016</td><td>7 days</td><td>06/01/2016</td><td>06/01/2016</td><td></td></tr>
<tr><td>05/25/2016</td><td>5 days</td><td></td><td></td><td></td></tr>
<tr><td>05/30/2016</td><td>5 days</td><td></td><td></td><td></td></tr>
<tr><td>05/04/2016</td><td>5 days</td><td></td><td></td><td></td></tr>
<tr><td>05/10/2016</td><td>6 days</td><td></td><td></td><td></td></tr>
<tr><td>05/18/2016</td><td>8 days</td><td></td><td></td><td></td></tr>
<tr><td>Soil:</td><td colspan="5">Not fumigated.</td></tr>
</table>

Strawberries / Botrytis Fruit Rot (*Botrytis cinerea*) #4: Trial No. KAK-2016-Sberry-MD: Results												
Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	App. No.	Incidence (%)		Marketable Fruit				
								Percent		Grams/Plant		
						Measured	Percent Control	Measured	Percent Increase	Measured	Percent Increase	
Untreated control (Water)			Not Applicable			14.4 b		67.5 a		114.3 a		
Oso 5%SC	6.5 fl oz	25	Polyoxin D zinc salt	19	1-9	5.6 ab	61.1	66.3 a	-1.88	114.1 a	-0.17	
Oso 5%SC	13 fl oz	50	Polyoxin D zinc salt	19	1-9	4.4 a	69.4	80.0 a	18.5	143.1 a	25.2	
Organic Std: • Regalia	4 qt		*Reynoutria sachalinensis* extract	P5	1-9	9.4 ab	34.7	67.5 a	0.00	115.9 a	1.34	
• Actinovate	12 oz		*Streptomyces lydicus*	NC	2,4,6,8							
• Silwet	0.8 qt		Non-ionic surfactant	NA	2-9							
• Serenade ASO	4 qt		*Bacillus subtilis* str. QST 713	44	3,5,7,9							
Treatment means followed by the same letter are not statistically different according to ANOVA and Tukey's multiple means comparison test at P = 0.05.												

Treatments were applied preventatively. Foliage remained healthy.

The researchers described the Botrytis fruit rot disease pressure as relatively low due to the cool spring.

No phytotoxicity was observed.

c. Discussion

This trial was conducted on the eastern shore of Maryland where humidity is high, pick-your-own strawberry farms are common, and soil fumigation is not used due to the close proximity of the Chesapeake Bay.

In this trial, Oso applied at 6.5 fl oz/acre and 13 fl oz/acre, in the absence of soil fumigation for pest control, provided:

- 61.1% and 69.4% control, respectively, of Botrytis fruit rot incidence; and
- -1.88% and 18.5% increased strawberry marketable fruit, respectively.

The local standard treatment program of organic strawberries includes Regalia, Actinovate, Silwet, and Serenade ASO and was evaluated in this trial. Treatment with Oso provided:

- *Superior* control of Botrytis fruit rot incidence compared to the organic standard treatment program; and
- *Superior* marketable strawberry yield compared to the organic standard treatment program.

#5: Trial No. KAK-2016-Sberry-MI

a. Design

<table>
<tr><td colspan="6">Strawberries / Botrytis Gray Mold (Botrytis cinerea) #5:
Trial No. KAK-2016-Sberry-MI: Design</td></tr>
<tr><td>Title:</td><td colspan="5">Evaluations of fungicides for control of leaf and fruit rot diseases in matted-row strawberry, 2016</td></tr>
<tr><td>Author and affiliation:</td><td colspan="5">A. M.C. Schilder, N. M. Gillett, and R. W. Sysak
Michigan State University</td></tr>
<tr><td>Publication:</td><td colspan="5">PDMR (planned for fall 2018 publication)</td></tr>
<tr><td>Location:</td><td colspan="5">Camden, MI</td></tr>
<tr><td>Crop:</td><td colspan="5">Strawberry (Fragarias x ananassa ‘Wendy’)</td></tr>
<tr><td>Disease name:</td><td colspan="5">Botrytis gray mold</td></tr>
<tr><td>Pathogen:</td><td colspan="5">Botrytis cinerea</td></tr>
<tr><td>Test plot design:</td><td colspan="5">Randomized complete block</td></tr>
<tr><td>Number of replicates:</td><td colspan="5">4</td></tr>
<tr><td>Application equipment:</td><td colspan="5">Handheld Smith Contractor Sprayer (29 psi)</td></tr>
<tr><td>Spray volume:</td><td colspan="5">75 gal/acre</td></tr>
<tr><td>Application type(s):</td><td colspan="5">Preventative</td></tr>
<tr><td>Number of applications:</td><td colspan="5">7</td></tr>
<tr><td rowspan="9">Chronology:</td><td colspan="4">Application</td><td rowspan="2">Disease Assessment Dates (Berries)</td><td rowspan="2">Harvest Dates</td></tr>
<tr><td>No.</td><td>Date</td><td>Interval</td><td>Growth Stage</td></tr>
<tr><td>1</td><td>05/09/2016</td><td></td><td>Green up</td><td rowspan="7">06/23/2016</td><td rowspan="7">06/16/2016
06/24/2016</td></tr>
<tr><td>2</td><td>05/18/2016</td><td>9 days</td><td>Bloom</td></tr>
<tr><td>3</td><td>05/24/2016</td><td>6 days</td><td>2nd bloom after frost</td></tr>
<tr><td>4</td><td>06/01/2016</td><td>7 days</td><td>Bloom and green fruit</td></tr>
<tr><td>5</td><td>06/07/2016</td><td>6 days</td><td>Green fruit</td></tr>
<tr><td>6</td><td>06/15/2016</td><td>7 days</td><td>Green and red fruit</td></tr>
<tr><td>7</td><td>06/23/2016</td><td>8 days</td><td>Red fruit</td></tr>
<tr><td>Disease assessment methodology:</td><td colspan="5">• Visual field ratings: 50 berries were selected randomly.
• Disposable gloves were used to pick berries and changed between plots to reduce cross-contamination.
• Harvest was from the center of plots.
• Post-harvest: 25 marketable berries from each plot were placed equidistant on metal screens in aluminum trays and incubated at 72°F and 100% relative humidity. After 4 days, the berries were inspected for fungal sporulation.</td></tr>
</table>

b. Results

Strawberries / Botrytis Gray Mold (*Botrytis cinerea*) #5: Trial No. KAK-2016-Sberry-MI: Results										
Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	Field Incidence (%)		4-Day Post-Harvest [A] Incidence (%) (1st Harvest; 6/16/2016)		4-Day Post-Harvest [A] Marketable Fruit(%) (1st Harvest; 6/16/2016)	
					Measured	Percent Control	Measured	Percent Control	Measured	Percent Increase
Untreated control			Not Applicable		39.0 a		39.0 a		7.5 a	
Oso 5%SC	6.5 fl oz	25	Polyoxin D zinc salt	19	6.0 b	85	27.0 cd	31	28.0 bc	273
Oso 5%SC	13 fl oz	50	Polyoxin D zinc salt	19	5.5 bc	86	25.0 cd	36	25.0 b	233
Serifel	4 oz		*Bacillus amyloliquefanciens* strain MBI 600	44	3.5 bc	91	35.0 bc	10	27.0 bc	260
Serifel	4 oz		*Bacillus amyloliquefanciens* strain MBI 600	44	6.5 b	83	21.0 d	46	38.0 c	407
Pristine	11.5 oz		Boscalid	7						
			Pyraclostrobin	11						
Treatment means followed by the same letter are not statistically different according to Fisher's Protected LSD test at $P \leq 0.05$. A. Harvested 1 day after last application. All berries used in the post-harvest incubation test appeared marketable (no visible disease or soft areas) before incubation started.										

The first assessments were performed after the last treatment. Therefore, all treatments are assumed to be preventative.

No phytotoxicity was observed.

c. Discussion

In this trial, Oso applied at 13 fl oz/acre provided:

- 86% control of field incidence of Botrytis fruit rot on strawberries; and
- 233% increased 4-day post-harvest marketable strawberries.

OMRI-listed products evaluated in this trial included Serifel. Oso applied at both 6.5 fl oz/acre and at 13 fl oz/acre provided control of Botrytis on strawberries that was statistically *equivalent* to the field and post-harvest control of Botrytis provided by Serifel.

#6: Trial No. KAK-2017-Sberry-MI

a. Design

Strawberries / Botrytis Gray Mold (*Botrytis cinerea*) #6: Trial No. KAK-2017-Sberry-MI: Design				
Title:	Evaluation of fungicides for control of leaf and fruit rot diseases in matted-row strawberry, 2017			
Author and affiliation:	A. M. C. Schilder, J. M. Gillett, and R. W. Sysak Michigan State University			
Publication:	PDMR (planned for fall 2018 publication)			
Location:	Camden, MI			
Crop:	Strawberry (*Fragaria* x *ananassa* 'Wendy')			
Disease name:	Botrytis gray mold			
Pathogen:	*Botrytis cinerea*			
Test plot design:	Randomized complete block			
Number of replicates:	4			
Application equipment:	Smith Contractor Sprayer (29 psi)			
Spray volume:	75 gallons/acre			
Application type(s):	Preventative			
Number of applications:	5			
Chronology:	Application Dates	Application Interval (days)	Growth Stage	Disease Assessment Dates
	05/01/2017		Green up	06/22/2017 (field ratings)
	05/07/ 2017	7	50% bloom	06/26/2017 (post-harvest ratings)
	05/24/2017	17	Bloom	
	05/31/2017	7	Bloom and green fruit	
	06/14/2017	14	Red fruit	
Disease assessment methodology (post-harvest):	25 marketable berries from each plot were placed equidistantly on metal screens in aluminum trays and incubated at room temperature and 100% relative humidity. After 4 days, berries were visually assessed for final sporulation.			

b. Results

Strawberries / Botrytis Gray Mold (*Botrytis cinerea*) #6: Trial No. KAK-2017-Sberry-MI: Results									
Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	App Code	Field Rating of Botrytis Gray Mold on Fruit		4-Day Post-Harvest Marketable Fruit	
						Incidence (%)	Control (%)	Incidence (%)	Increase (%)
Untreated control			Not Applicable			53.5 a		2.0 a	
Oso 5%	13 fl oz	50	Polyoxin D zinc salt	19	ABCDE	3.3 b	94	49.0 b	2350
Standard program:									
Topsin	4.5 fl oz		Thiophanate-methyl	1	A	3.3 b	94	40.0 b	1900
Captan 4L	3 qt		Captan	M4	A				
Fontelis	24 fl oz		Penthiopyrad	7	BCE				
Switch 62.5	12 oz		Cyprodinil	9	D				
			Fludioxonil	12					
Treatment means followed by the same letter are not statistically different according to the Fisher's Protected LSD test at P ≤ 0.05.									

The researchers described the Botrytis disease pressure in the field as moderately high.

No phytotoxicity was observed.

c. Discussion

In this trial, Oso applied at 13 fl oz/acre provided:

- 94% control of Botrytis fruit rot on strawberries; and
- 2350% increased 4-day post-harvest marketable strawberries.

No OMRI-listed products were evaluated in this trial.

EVALUATION OF ORGANIC GROWER NEED

STEP 1: Cumulative Efficacy Data Summary for Polyoxin D Zinc Salt Petitioned Uses

Efficacy data for the polyoxin D zinc salt 5SC formulation summarized in the May 31, 2016 petition and this addendum for which polyoxin D zinc salt was used in the absence of other fungicide products is further summarized below. The table below includes mean percent control data based upon the application rate. Curative treatments are highlighted. Non-ionic surfactants and other adjuvants are noted when used.

Cumulative Summary of the Efficacy of the Polyoxin D Zinc Salt 5SC Suspension Concentrate Fungicide (EPA Reg. No. 68173-4) and Oso 5%SC Fungicide (EPA Reg. No. 68173-4-70051) Applied as a Foliar Spray to Growing Food Crops Using Ground Application Equipment

Disease	Pathogen	Crop Tested & Sequence No.	Trial No.	State	Formulation [1]	No. App.	Application Interval (Days)	Application Rate		Mean Control (%)		Mean Yield Increase (%)	Application Type(s)	Inocu-lated?	Max. Pest Pressure in UTC (%)	Phyto-tox ?	Publication Status	Notes
								fl oz/ acre	g a.i./ ha	Leaves	Fruit							
CROP GROUP 1: ROOT AND TUBER VEGETABLES																		
Early Blight	*Alternaria solani*	Potatoes #1	CER-2011-029	MI	CX-10440	8	7	3.8	15	19.3	NA	26.4	Preventative and curative	No	45.0	No	PDMR 6:V107	
								7.5	29	22.2	NA	6.9						
		Potatoes #2	CER-2011-030	PA	CX-10440	4	14 - 18	3.75	14	18.1	NA	NA	Preventative and curative	Yes	AUDPC = 922.6	No	PDMR 6:V113	
								7.5	29	39.7	NA	NA						
		Potatoes #3	CER-2012-028	PA	CX-10440	7	7 - 8	6.5	25	41.9	NA	13.5	Preventative and curative	Yes	AUDPC = 340	No	PDMR 7:V105	
								13	50	41.9	NA	6.5						
							Mean	3.75 - 3.8	14 - 15	18.7	NA	26.4						
								6.5 - 7.5	25 - 29	34.6	NA	10.2						
								13	50	41.9	NA	6.5						
Late Blight	*Phytophthora infestans*	Potatoes #1	CER-2012-027	PA	CX-10440	5	7	13	50	10.1	NA	13.9	Preventative and curative	Yes	AUDPC = 1612	No	PDMR 7:V094	
Tan Spot	*Botrytis cinerea*	Potatoes #1	CER-2011-029	MI	CX-10440	8	7	3.8	15	74.9	NA	26.4	Preventative	No	35.0	No	PDMR 6:V107	
								7.5	29	71.4	NA	6.9						
CROP GROUP 4: LEAFY VEGETABLES (EXCEPT BRASSICA VEGETABLES)																		
Downy Mildew	*Bremia lactucae*	Lettuce #1	CER-2011-046	CA	CX-10440	4	14 - 15	3.75	14	47.5	NA	NA	Preventative and curative	No	100	No	Certis data; not published.	
								7.5	29	33.7	NA	NA						
		Lettuce #2	CER-2013-014	CA	Oso	8	7	6.5	25	50	NA	NA	Preventative and curative	No	12.58 lesions/ head	No	Certis data; not published.	
								13	50	62	NA	NA						
		Lettuce #3	CER-2013-032	CA	Oso + Syl-Tak (surfactant; 4 fl oz/A)	4	6 - 10	13	50	46.2	NA	NA	Preventative	No	4.26 lesions/ head	No	Not published. Permission received.	
							Mean	3.75	14	47.5	NA	NA						
								6.5 -7.5	25 -29	42	NA	NA						
								13	50	54	NA	NA						
Gray Mold	*Botrytis cinerea*	Lettuce #1	CER-2011-014	CA	CX-10440	4	10 - 11	3.75	14	30.0	NA	6.1	Preventative	No	52.62	No	Certis data; not published.	
								7.5	29	41.7	NA	6.5						

Cumulative Summary of the Efficacy of the Polyoxin D Zinc Salt 5SC Suspension Concentrate Fungicide (EPA Reg. No. 68173-4) and Oso 5%SC Fungicide (EPA Reg. No. 68173-4-70051) Applied as a Foliar Spray to Growing Food Crops Using Ground Application Equipment

Disease	Pathogen	Crop Tested & Sequence No.	Trial No.	State	Formulation [1]	No. App.	Application Interval (Days)	Application Rate		Mean Control (%)		Mean Yield Increase (%)	Application Type(s)	Inocu-lated?	Max. Pest Pressure in UTC (%)	Phyto-tox ?	Publication Status	Notes
								fl oz/ acre	g a.i./ ha	Leaves	Fruit							
Powdery Mildew	*Golovinomyces cichoracearum*	Lettuce #1	CER-2012-074	AZ	CX-10440	4	8 - 11	3.75	14	69	NA	NA	Preventative and curative	No	3.9 (0-5 scale)	No	PMDR 8:V199	
								6.5	25	69	NA	NA						
White Rust	*Albugo occidentalis*	Spinach #1	CER-2014-063	TX	Oso	4	5 - 9	6.5	25	53	NA	NA	Curative	No	100	No	Not published. Permission received.	Disease present before first application.
		Spinach #2	CER-2015-152	TX	Oso + Induce (non-ionic surfactant; 4 oz/A)	4	11 - 15	6.5	25	49	NA	NA	Preventative	No	4.5 on 1 to 10 scale	No	Not published. Permission received.	New data.
							Mean	6.5	25	51	NA	NA						
CROP GROUP 8: FRUITING VEGETABLES																		
Early Blight	*Alternaria solani*	Tomatoes #1	CER-2014-095	FL	Oso	8	6 - 9	6.5	50	38.4	NA	NA	Preventative and curative	Yes	55.0	No	PDMR 9:V072	
Late Blight	*Phytophthora infestans*	Tomatoes #1	CER-2011-027	FL	CX-10440	4	6 - 8	7.5	29	64.3	NA	NA	Preventative	No	546.0 lesions/ plot	No	Not published. Permission received.	
Powdery Mildew	*Leviellula taurica*	Tomatoes #1	CER-2012-016	CA	CX-10440	3	9 - 14	13	50	47.3	NA	14.5	Curative	No	93.5	No	Not published. Permission received.	See also *Odium neolycopersici*.
Powdery Mildew	*Odium neoplycopersici*	Tomatoes #1	BCGGA-2015-03	Green-house	Oso	4	7	4.1	15	84.8	NA	3.5	Preventative and curative	Yes	62.5	No	Canadian Journal Plant Pathology	See also *Leviellula taurica*.
								6.8	26.2	86.9	NA	11.4						
								13.7	52.7	90.2	NA	14.8						
						2	14	13.7	52.7	82.5	NA	-6.3						
								20.5	75	82.9	NA	19.3						
							Mean	4.1	15	84.8	NA	3.5						
								6.8	26.2	86.9	NA	11.4						
								13.7	52.7	86.4	NA	4.3						
								20.5	75	82.9	NA	19.3						
Target Spot	*Corynespora cossiicola*	Tomatoes #1	CER-2014-095	FL	Oso	8	6 - 9	6.5	25	38.4	NA	NA	Preventative and curative	Yes	55.0	No	PDMR 9:V072	

Cumulative Summary of the Efficacy of the Polyoxin D Zinc Salt 5SC Suspension Concentrate Fungicide (EPA Reg. No. 68173-4) and Oso 5%SC Fungicide (EPA Reg. No. 68173-4-70051) Applied as a Foliar Spray to Growing Food Crops Using Ground Application Equipment

Disease	Pathogen	Crop Tested & Sequence No.	Trial No.	State	Formulation [1]	No. App.	Application Interval (Days)	Application Rate		Mean Control (%)		Mean Yield Increase (%)	Application Type(s)	Inocu-lated?	Max. Pest Pressure in UTC (%)	Phyto-tox ?	Publication Status	Notes
								fl oz/ acre	g a.i./ ha	Leaves	Fruit							
CROP GROUP 9: CUCURBIT VEGETABLES																		
Anthracnose	*Colletotrichum orbiculare*	Watermelon #1	CER-2014-057	TX	Oso + Capsil (surfactant; 12 fl oz/100 gal)	7	6 - 11	6.5	25	82	NA	3.3	Preventative and curative	No	1.38 (Scale of 0 to 5)	No	Not published. Permission received.	Phytotoxicity observed in alternative treatment program: chlorothalonil + mancozeb + zoxamide.
Gummy Stem Blight	*Didymella bryoniae*	Cantaloupe #1	IND-2012-125	Green-house	CX-10440	1	Not Applicable	14	54	86.7	NA	NA	Preventative	Yes	100		Permission received. Submitted to Plant Health Progress.	Phytotoxicity observed for alternatives: Armicarb and Organocide.
		Cucumber #1	BCGGA-2015-02	Green-house	Oso	4	7	13.7	52.7	61.0	NA	20.3	Preventative and curative	Yes	90.8	No	Canadian Journal Plant Pathology	20.5 fl oz/acre exceeds labeled rate.
						2	14	13.7	52.7	60.7	NA	15.8						
						2	14	20.5	75	58.9	NA	21.9						
		Watermelon #1	CER-2011-028	SC	CX-10440	7	7 - 12	27	27	33.6	NA	NA	Preventative and curative	Yes	99.9	No	PDMR 6:V023	Exceeds labeled rate.
								54	51	62.5	NA	NA						
		Watermelon #2	CER-2012-051	GA	CX-10440	7	5 - 9	6.5	25	25.7	NA	NA	Curative	Yes	85.0	No	Submitted to Plant Health Congress. Permission received.	Inoculated 20 days before first fungicide treatment.
								13.0	50	30.6	NA	NA						
							Mean	6.5	25	25.7	NA	NA						
								13.0 - 14	50 - 54	57	NA	18.1						
								20.5	75	58.9	NA	21.9						
Powdery Mildew	*Podosphaera xanthii*	Cucumbers #1	R-14-10-0	Green-house	Veggieturbo 5SC	2	7	6.5	25	80	NA	NA	Curative	Yes	80.0	No	Kaken data; not published.	Disease confirmed before first treatment.
								13	50	81	NA	NA						
		Pumpkins #1	CER-2015-145	IL	Oso + Activator (non-ionic surfactant; 0.125%)	7	6 - 8	6.5	25	67	NA	NA	Preventative and curative	No	30	No	Not published. Permission received.	
		Pumpkin #2	CER-2015-149	GA	Oso	5	7	6.5	25	51.7	NA	NA	Preventative	No	72.5 (0 to 100 scale; 100 = Plant mortality.	No	Not published. Permission received.	
							Mean	6.5	25	66	NA	NA						
								13	50	81	NA	NA						

Cumulative Summary of the Efficacy of the Polyoxin D Zinc Salt 5SC Suspension Concentrate Fungicide (EPA Reg. No. 68173-4) and Oso 5%SC Fungicide (EPA Reg. No. 68173-4-70051) Applied as a Foliar Spray to Growing Food Crops Using Ground Application Equipment

Disease	Pathogen	Crop Tested & Sequence No.	Trial No.	State	Formulation [1]	No. App.	Application Interval (Days)	Application Rate		Mean Control (%)		Mean Yield Increase (%)	Application Type(s)	Inocu-lated?	Max. Pest Pressure in UTC (%)	Phyto-tox ?	Publication Status	Notes
								fl oz/ acre	g a.i./ ha	Leaves	Fruit							
Downy Mildew	*Pseudo-peronospora cubensis*	Cucumber #1	CER-2012-067	DE	CX 10440	5	5 - 7	6.5	25	57.1	NA	37.1	Preventative	No	17.5	No	Not published. Permission received.	
								13	50	37.1	NA	18.0						
		Pumpkin #1	CER-2015-145	IL	Oso + Activator (non-ionic surfactant; 0.125%)	7	6 - 8	6.5	25	78	NA	NA	Preventative and curative	No	20.75	No	Not published. Permission received.	
							Mean	6.5	25	68	NA	37.1						
								13	50	37.1	NA	18.0						
Southern Blight	*Sclerotinium rolfsii*	Squash #1	CER-2012-050	GA	CX-10440	9	7	6.5	25	NA	59	482	Preventative	No	2 on a 1 to 10 scale	No	Certis data; not published.	Foliar treatment.
								13	50	NA	82	552						
CROP GROUP 11: POME FRUITS																		
Fly Speck	*Zygophiala jamaicensis*	Apples #1	CER-2012-025	VA	CX-10440	9	12 - 20	6.5	25	NA	93	NA	Preventative and curative	No	87	No	PDMR 7:PF034	
								13	50	NA	70	NA						
Powdery Mildew	*Podosphaera leucotricha*	Apples #1	CER-2012-020	WA	CX-10440	5	6 - 14	6.5	25	56	NA	NA	Preventative and curative	No	35.5	No	Certis data; not published.	
								13.0	50	54	NA	NA						
		Apples #2	CER-2015-012	WA	Oso	5	8 - 27	6.5	25	14.4	78.2	NA	Preventative and curative	No	61.3	No	Certis data; not published.	
		Apples #3	CER-2015-034	WA	Oso + sticker/ spreader (R-56 or SB56; not specified; rate not reported)	6	13 - 19	6.5	25	40.5	NA	NA	Preventative and curative	No	30.8	No	Certis data; not published.	
		Apples #4	CER-2015-033	WA	Oso + R-56 (sticker/ spreader; 0.25%; v/v)	1	NA	6.5	25	NA	10.4	NA	Preventative	No	96.0	No	Certis data; not published.	New data. Storage rot; fruit punctured and not punctured.
							Mean	6.5	25	37	44.3	NA						
								13.0	50	54	NA	NA						
Scab	*Venturia inaequalis*	Apples #1	CER-2012-025	VA	CX-10440	9	12 - 28	6.5	25	53	62	NA	Curative	No	87	No	PDMR 7:PF034	Scab was present before the first fungicide application.
								13	50	13	46	NA						
Sooty Blotch Complex	*Geastrumia polystigmatus*, etc.	Apples #1	CER-2012-025	VA	CX-10440	9	12 - 28	6.5	25	NA	79	NA	Preventative and curative	No	94	No	PDMR 7:PF034	
								13	50	NA	56	NA						

Cumulative Summary of the Efficacy of the Polyoxin D Zinc Salt 5SC Suspension Concentrate Fungicide (EPA Reg. No. 68173-4) and Oso 5%SC Fungicide (EPA Reg. No. 68173-4-70051) Applied as a Foliar Spray to Growing Food Crops Using Ground Application Equipment

Disease	Pathogen	Crop Tested & Sequence No.	Trial No.	State	Formulation [1]	No. App.	Application Interval (Days)	Application Rate		Mean Control (%)		Mean Yield Increase (%)	Application Type(s)	Inoculated?	Max. Pest Pressure in UTC (%)	Phyto-tox ?	Publication Status	Notes
								fl oz/ acre	g a.i./ ha	Leaves	Fruit							
CROP GROUP 12: STONE FRUITS																		
Brown Rot Blossom Blight	*Monilinia fructicola* and *Monilinia laxa*	Cherries #1	CER-2015-035	OR	Oso + Induce (wetter/ sticker; 32 fl oz/100 gal)	7	7 - 14	6.5	25	96.5	NA	NA	Preventative and curative	No	14.3	No	PDMR 10:STF009	Applications initiated before bloom.
		French prunes #1	CER-2013-121	CA	CX-10440	1	NA	6	23	85.9	NA	NA	Curative	Yes	65.1	No	UC Repository 07 CPB 6	Inoculated 24 hr before first treatment.
										97.3	NA	NA	Preventative	Yes	63.8			Inoculated 4 hr after first treatment.
							Mean	6 - 6.5	23 - 25	93.2	NA	NA						
Brown Rot Fruit Rot	*Monilinia fructicola*	Nectarines #1	CER-2013-119	CA	CX-10440	1	NA	3.5	13	NA	18	NA	Preventative	Yes (post-har-vest)	85.3	No	Internet (Adaskaveg, 2013)	Pre-harvest treatment. Post-harvest inoculation and evaluation.
								13	50	NA	20	NA						
		Peaches #1						3.5	13	NA	13	NA			67.9			
								13	50	NA	19	NA						
		Cherries #1	CER-2015-035	OR	Oso + Induce (wetter/ sticker; 32 fl oz/100 gal)	7	7 - 14	6.5	25	NA	78	NA	Preventative and curative	No	6.0	No	PDMR 10:STF009	Pre-harvest treatment. Post-harvest evaluation.
							Mean	3.5	13	NA	16	NA						
								6.5	25	NA	19	NA						
								13	50	NA	20	NA						
Powdery Mildew	*Podosphaera clandestina*	Cherries #1	CER-2015-032	WA	Oso + R-56 (spreader/ sticker; 32 fl oz/100 gal)	4	14 - 15	6.5	25	60.0	NA	NA	Preventative and curative	No	89.0	No	Certis data; not published.	
		Cherries #2	CER-2015-035	OR	Oso + Induce (wetter/ sticker; 32 fl oz/100 gal)	7	7 - 14	6.5	25	19.6	NA	NA	Preventative	No	53.3	No	PDMR 10:STF009	New data. Applications initiated before bloom.
							Mean	6.5	25	39.8	NA	NA						

Cumulative Summary of the Efficacy of the Polyoxin D Zinc Salt 5SC Suspension Concentrate Fungicide (EPA Reg. No. 68173-4) and Oso 5%SC Fungicide (EPA Reg. No. 68173-4-70051) Applied as a Foliar Spray to Growing Food Crops Using Ground Application Equipment

Disease	Pathogen	Crop Tested & Sequence No.	Trial No.	State	Formulation [1]	No. App.	Application Interval (Days)	Application Rate		Mean Control (%)		Mean Yield Increase (%)	Application Type(s)	Inocu-lated?	Max. Pest Pressure in UTC (%)	Phyto-tox ?	Publication Status	Notes
								fl oz/ acre	g a.i./ ha	Leaves	Fruit							
CROP GROUP 13: BERRIES AND SMALL FRUITS: BLUEBERRIES																		
Alternaria Fruit Rot	Alternaria spp.	Blueberries #1	CER-2012-049	MI	CX-10440	5	10 - 39	6.5	25	NA	31	NA	Preventative	No	48.5	No	PDMR 7:SMF014	Pre-harvest treatment. Post-harvest evaluation.
								13.0	50	NA	51	NA						
Gray Mold	*Botrytis cinerea*	Blueberries #1	CER-2015-009	OR	Oso + Kinetic (sticker/ spreader; 6 fl oz/100 gal)	12	Typically 6-8	5.6	22	NA	72	NA	Preventative	No	7.8	No	PDMR 10:SMF027	
						7	13-15	5.6	22	NA	87	NA						
							Mean	5.6	22	NA	80	NA						
Mummyberry	*Monilinia vaccinii-corymbosi*	Blueberries #1	CER-2015-008	OR	Oso + Induce (wetter/ sticker; 6 fl oz/100 gal)	9	4 - 8	5.6	21.6	NA	21.3	NA	Preventative and curative	No	34.8	No	PDMR 10:SMF026	
		Blueberries #2	CER-2015-143	MI	Oso + LI 700 (penetrant, acidifier; 0.125% v/v)	5	7 - 14	6.5	25	89	94	NA	Preventative	No	46.5 mummies/ bush	No	PDMR 10:SMF009	
		Blueberries #3	KAK-2016-Blueberry-MI	MI	Oso	8	8 - 23	6.5	25	90.8	90.7	NA	Preventative and curative	No	57.8 shoot strikes/ bush	No	PDMR (Planned fall 2018 publication) (Permission)	New data.
								13	50	100	100	NA						
					Oso + LI 700 (penetrant, acidifier; 0.125% v/v)			6.5	25	87.9	88.2	NA						
		Blueberries #4	KAK-2016-Blueberry-WA-Conv	WA	Oso	6	10 - 16	6.5	25	83.0	84.3	NA	Preventative	No	17.8 Mummies/ bush	No	Permission.	New data.
								13	50	83.0	87.1							
		Blueberries #5	KAK-2016-Blueberry-WA-Org	WA	Oso	7	6 - 9	6.5	25	-64.4	17.8	NA	Preventative	No	45.0 (fruit)	No	Permission.	New data. Includes Oso with microbial pesticides.
								13	50	32.5	30.0	NA						
		Blueberries #6	KAK-2017-Blueberry-WA-Org	WA	Oso	7	5 - 11	6.5	25	NA	63	NA	Preventative	No	6.3	No	Permission.	New data. Includes Oso with microbial pesticides.
								13	50	NA	68	NA						
							Mean Conven-tional	5.6 - 6.5	21.6 - 25	88	77	NA						
								13	20	91.5	93.6	NA						
							Mean Organic	6.5	25	-64.4	40	NA						
								13	50	32.5	49	NA						

Cumulative Summary of the Efficacy of the Polyoxin D Zinc Salt 5SC Suspension Concentrate Fungicide (EPA Reg. No. 68173-4) and Oso 5%SC Fungicide (EPA Reg. No. 68173-4-70051) Applied as a Foliar Spray to Growing Food Crops Using Ground Application Equipment

Disease	Pathogen	Crop Tested & Sequence No.	Trial No.	State	Formulation [1]	No. App.	Application Interval (Days)	Application Rate		Mean Control (%)		Mean Yield Increase (%)	Application Type(s)	Inocu-lated?	Max. Pest Pressure in UTC (%)	Phyto-tox ?	Publication Status	Notes
								fl oz/ acre	g a.i./ ha	Leaves	Fruit							
CROP GROUP 13: BERRIES AND SMALL FRUITS: CANEBERRIES																		
Botrytis Fruit Rot	*Botrytis cinerea*	Raspberries #1	IND-2015-rasp	WA	Oso	6	10	12	46	NA	51.1	NA	Preventative	No	19.0	No	Permission.	
		Raspberries #2	IND-2016-Rasp-WA	WA	Oso	6	9 - 12	12	46	NA	52.4	NA	Preventative	No	21.0	No	Permission.	New data.
		Raspberries #3	KAK-2017-Rasp-MI	MI	Oso	5	7 - 14	6.5	25	NA	81	NA	Preventative	No	53.3	No	PDMR (Planned fall 2018 publication) (Permission)	New data.
								13	50	NA	100	NA						
							Mean	12	46	NA	51.8	NA						
Powdery Mildew	*Podosphaera aphanis*	Blackberries #1	CER-2012-060	OR	CX-10440	3	12 - 14	3.75	12.5	NA	42	NA	Preventative	No	60.0	No	Certis data; not published.	
								6.5	25	NA	58	NA						
		Raspberries #1	KAK-2017-Rasp-MI	MI	Oso	5	7 - 14	6.5	25	97	NA	NA	Preventative	No	57.3	No	PDMR (Planned fall 2018 publication) (Permission)	New data.
								13	50	100	NA	NA						
							Mean	3.75	12.5	NA	42	NA						
								6.5	25	97	58	NA						
								13	50	100	NA	NA						
CROP GROUP 13: BERRIES AND SMALL FRUITS: CRANBERRIES																		
Cottonball	*Monilinia oxycocci*	Cranberries #1	IND-2014-165	WI	Tavano 5SC	2	14	6.5	25	NA	16	NA	Preventative	No	32	No	PDMR 9:SMF014	City Point
								6.5	25	NA	38	NA			21			Warrens
		Cranberries #2	IND-2015-208	WI	Oso	2	9	6.5	25	NA	68.1	22.0	Preventative	No	16.6	No	PDMR 10:SMF007	
					Oso + X77 (non-ionic spreader; 0.25% v/v)	2	9	6.5	25	NA	54.8	17.3	Preventative	No	16.6	No		
		Cranberries #3	11:SMF011 (2016; WI)	WI	Oso + X77 (non-ionic spreader; 0.25% v/v)	2	8	6.5	25	NA	66	17.0	Preventative	No	11.9	No	PDMR 11:SMF011	New data; City Point.
					Oso + X77 (non-ionic spreader; 0.25% v/v)	2	12	6.5	25	NA	46	6.53	Preventative	No	10.7	No		New data; Warrens.
							Mean	6.5	25	NA	48	15.7						

Cumulative Summary of the Efficacy of the Polyoxin D Zinc Salt 5SC Suspension Concentrate Fungicide (EPA Reg. No. 68173-4) and Oso 5%SC Fungicide (EPA Reg. No. 68173-4-70051) Applied as a Foliar Spray to Growing Food Crops Using Ground Application Equipment

Disease	Pathogen	Crop Tested & Sequence No.	Trial No.	State	Formulation [1]	No. App.	Application Interval (Days)	Application Rate		Mean Control (%)		Mean Yield Increase (%)	Application Type(s)	Inoculated?	Max. Pest Pressure in UTC (%)	Phyto-tox ?	Publication Status	Notes
								fl oz/ acre	g a.i./ ha	Leaves	Fruit							
Fruit rot complex	*Coleophoma empetri*, *Colletotrichum acutatum*, *Colletotrichum gloeosporioides*, *Phyllosticta vaccinii*, and *Physalospora vaccinii*, etc.	Cranberries #1	IND-2014-166	WI	Tavano 5SC	2	9	6.5	25	NA	50	0	Preventative	No	18.1	No	PDMR 9:SMF015	
		Cranberries #2a	CER-2015-104	WI	Oso + X77 (Non-ionic spreader; 0.25%)	2	19	6.5	25	NA	84.3	0	Preventative	No	23.6	No	PDMR 10:SMF008	Warrens
					Oso	2	19	13	50	NA	60.6	-1.9						
		Cranberries #2b	CER-2015-104	WI	Oso + X77 (Non-ionic spreader; 0.25%)	2	14	6.5	25	NA	90.2	34.9	Preventative	No	45.0	No	PDMR 10:SMF008	Valley Junction
		Cranberries #2c	CER-2015-104	WI	Oso + X77 (Non-ionic spreader; 0.25%)	2	9	6.5	25	NA	68.5	2.1	Preventative	No	30.5	No	PDMR 10:SMF008	Plainfield
					Oso			13	50	NA	63.9	-2.4						
		Cranberries #2d	CER-2015-104	WI	Oso + X77 (Non-ionic spreader; 0.25%)	2	19	6.5	25	NA	78.4	29.0	Preventative	No	22.2	No	PDMR 10:SMF008	Oakdale
					Oso			13	50	NA	81.1	29.5						
		Cranberries #3	11:SMF012 (2016; WI)	WI	Oso + X77 (non-ionic spreader; 0.25% v/v)	2	11	6.5	25	NA	78.0	-84	Preventative	No	31.3	No	PDMR 11:SMF012	New data; Oakdale.
					Oso + X77 (non-ionic spreader; 0.25% v/v)	2	11	6.5	25	NA	87.2	68.8	Preventative	No	35.2	No	PDMR 11:SMF012	New data; Valley Junction.
					Oso + X77 (non-ionic spreader; 0.25% v/v)	2	14	6.5	25	NA	56.0	-19.0	Preventative	No	40.5	No	PDMR 11:SMF012	New data; Warrens.
					Oso + X77 (non-ionic spreader; 0.25% v/v)	2	11	6.5	25	NA	28.1	42.9	Preventative	No	61.6	No	PDMR 11:SMF012	New data; Mather.
					Oso + X77 (non-ionic spreader; 0.25% v/v)	2	14	6.5	25	NA	42.6	-15.2	Preventative	No	33.3	No	PDMR 11:SMF012	New data; Tomah.
							Mean	6.5	25	NA	66	6						
								13	30	NA	68.5	8.4						

Cumulative Summary of the Efficacy of the Polyoxin D Zinc Salt 5SC Suspension Concentrate Fungicide (EPA Reg. No. 68173-4) and Oso 5%SC Fungicide (EPA Reg. No. 68173-4-70051) Applied as a Foliar Spray to Growing Food Crops Using Ground Application Equipment

Disease	Pathogen	Crop Tested & Sequence No.	Trial No.	State	Formulation [1]	No. App.	Application Interval (Days)	Application Rate		Mean Control (%)		Mean Yield Increase (%)	Application Type(s)	Inocu-lated?	Max. Pest Pressure in UTC (%)	Phyto-tox ?	Publication Status	Notes
								fl oz/ acre	g a.i./ ha	Leaves	Fruit							
CROP GROUP 13: BERRIES AND SMALL FRUITS: GRAPES																		
Black Rot	*Guignardia bidwellii*	Grapes #1	KAK-2016-Grape-MI	MI	Oso	7	10 - 16	6.5	25	NA	87	NA	Preventative	No	82.0	No	PDMR (Planned fall 2018 publication) (Permission)	New data.
								13	50	NA	98							
		Grapes #2	KAK-2017-Grape-MI	MI	Oso	7	11 - 20	13	50	87	86	NA	Preventative	No	66.0	No	PDMR (Planned fall 2018 publication) (Permission)	New data.
		Grapes #3	KAK-2016-Grape-PA	PA	Oso	6	9 - 12	13	50	NA	2.5	NA	Preventative	Yes	55.0	No	PDMR 11:SMF009	New data. Mummies in the trellis.
		Grapes #4	KAK-2017-Grape-PA	PA	Oso	7	9 - 11	13	50	NA	36.1	NA	Preventative	Yes	85.8	No	PDMR (Submitted)	New data. Mummies in the trellis.
							Mean	6.5	25	NA	87	NA						
								13	50	87	55.7	NA						
Bunch Rot	*Botrytis cinerea*	Grapes #1	CER-2013-002	CA	Tavano 5% SC	4	37 - 56	6.5	25	NA	89.0	NA	Preventative	No	30.00	No	Certis data; not published.	
								13	50	NA	92.8							
		Grapes #2	CER-2013-021	CA	Tavano 5% SC	6	18 - 21	6.5	25	NA	83.2	NA	Preventative and curative	No	20.8	No	Certis data; not published.	
								13	50	NA	78.1							
		Grapes #3	CER-2014-045	NY	Tavano 5% SC	4	13 - 43	6.5	25	NA	37	NA	Preventative and curative	No	76.3	No	Not published. Permission received.	
		Grapes #4	CER-2015-115	NY	OSO	4	14 - 41	6.5	25	NA	69	NA	Preventative	No	96	No	Not published. Permission received.	
		Grapes #5	CER-2015-140	MI	Oso 5%SC + Super Spread 90 (non-ionic surfactant; 0.125% v/v)	4	20 - 29	6.5	25	NA	56	NA	Preventative	No	25	No	PDMR 10:SMF011	
		Grapes #6	9:SMF001	CA	Tavano 5% SC	3	35	6.5	25	NA	61.1	NA	Preventative	No	22.8	No	PDMR 9:SMF001	New data.
							Mean	6.5	25	NA	66	NA						
								13	50	NA	85	NA						

Cumulative Summary of the Efficacy of the Polyoxin D Zinc Salt 5SC Suspension Concentrate Fungicide (EPA Reg. No. 68173-4) and Oso 5%SC Fungicide (EPA Reg. No. 68173-4-70051) Applied as a Foliar Spray to Growing Food Crops Using Ground Application Equipment

Disease	Pathogen	Crop Tested & Sequence No.	Trial No.	State	Formulation [1]	No. App.	Application Interval (Days)	Application Rate		Mean Control (%)		Mean Yield Increase (%)	Application Type(s)	Inocu-lated?	Max. Pest Pressure in UTC (%)	Phyto-tox ?	Publication Status	Notes
								fl oz/ acre	g a.i./ ha	Leaves	Fruit							
Downy Mildew	*Plasmopara viticola*	Grapes #1	KAK-2016-Grape-MI	MI	Oso	7	7 - 16	6.5	25	92	NA	NA	Preventative	No	83.0	No	PDMR (Planned fall 2018 publication) (Permission)	New data.
								13	50	99	NA	NA						
		Grapes #2	KAK-2017-Grape-MI	MI	Oso	7	11 - 20	13	50	NA	95	NA	Preventative	No	78.0	No	PDMR (Planned fall 2018 publication) (Permission)	New data.
							Mean	6.5	25	92	NA	NA						
								13	50	99	95	NA						
Phomopsis Fruit Rot	*Phomopsis viticola*	Grapes #1	KAK-2016-Grape-MI	MI	Oso	7	10 - 16	6.5	25	Rachis: 6.8	67	NA	Preventative	No	57.0	No	PDMR (Planned fall 2018) (Permission)	New data.
								13	50	9.6	96	NA						
		Grapes #2	KAK-2017-Grape-MI	MI	Oso	7	11 - 20	13	50	NA	97	NA	Preventative	No	88.0	No	PDMR (Planned fall 2018) (Permission)	New data.
							Mean	6.5	25	Rachis: 6.8	Fruit: 67	NA						
								13	50	9.6	97	NA						

Cumulative Summary of the Efficacy of the Polyoxin D Zinc Salt 5SC Suspension Concentrate Fungicide (EPA Reg. No. 68173-4) and Oso 5%SC Fungicide (EPA Reg. No. 68173-4-70051) Applied as a Foliar Spray to Growing Food Crops Using Ground Application Equipment

Disease	Pathogen	Crop Tested & Sequence No.	Trial No.	State	Formulation [1]	No. App.	Application Interval (Days)	Application Rate		Mean Control (%)		Mean Yield Increase (%)	Application Type(s)	Inocu-lated?	Max. Pest Pressure in UTC (%)	Phyto-tox ?	Publication Status	Notes
								fl oz/ acre	g a.i./ ha	Leaves	Fruit							
Powdery mildew	*Erysiphe necator*	Grapes #1	CER-2011-013	CA	CX-10440	8	10 - 11	3.75	14	78.1	78.6	NA	Preventative and curative	No	70.3	No	Certis data; not published.	
								7.5	29	80.4	68.8							
		Grapes #2	CER-2012-069	CA	CX-10440	8	9 - 11	13	50	NA	96.67	NA	Preventative and curative	No	30.00	No	Certis data; not published.	Wine was analyzed.
		Grapes #3	CER-2013-021	CA	Tavano	5	18 - 21	6.5	25	NA	44.2	NA	Preventative and curative	No	100	No	Certis data; not published.	
								13	50	NA	73.6	NA						
		Grapes #4	CER-2015-019	OR	Oso + Sylguard (silicone surfactant; 0.025% v/v)	6	13 - 15	6.5	25	86.1	47.9	NA	Preventative and curative	No	87.5	No	Certis data; not published.	
		Grapes #5	CER-2015-140	MI	Oso 5%SC + Super Spread 90 (non-ionic surfactant; 0.125% v/v)	4	20 - 29	6.5	25	55	56	NA	Preventative	No	37	No	PDMR 10:SMF011	
		Grapes #6	KAK-2016-Grape-MI	MI	Oso	7	10 - 16	6.5	25	90	88	NA	Preventative	No	63.0	No	PDMR (Planned fall 2018) (Permission)	New data.
								13	50	99	99							
		Grapes #7	KAK-2017-Grape-MI	MI	Oso	7	11 - 20	13	50	97	99	NA	Preventative	No	85.0	No	PDMR (Planned fall 2018) (Permission)	New data.
		Grapes #8	KAK-2017-Grape-PA	PA	Oso	7	9 - 11	13	50	81	84	NA	Preventative	No	98.0	No	PDMR (Planned fall 2018) (Permission)	New data.
							Mean	3.75	14	78.1	78.6	NA						
								6.5 - 7.5	25 - 29	78	61	NA						
								13	50	92	90	NA						

Cumulative Summary of the Efficacy of the Polyoxin D Zinc Salt 5SC Suspension Concentrate Fungicide (EPA Reg. No. 68173-4) and Oso 5%SC Fungicide (EPA Reg. No. 68173-4-70051) Applied as a Foliar Spray to Growing Food Crops Using Ground Application Equipment

Disease	Pathogen	Crop Tested & Sequence No.	Trial No.	State	Formulation [1]	No. App.	Application Interval (Days)	Application Rate		Mean Control (%)		Mean Yield Increase (%)	Application Type(s)	Inocu-lated?	Max. Pest Pressure in UTC (%)	Phyto-tox ?	Publication Status	Notes
								fl oz/ acre	g a.i./ ha	Leaves	Fruit							
CROP GROUP 13: BERRIES AND SMALL FRUITS: STRAWBERRIES																		
Anthracnose Fruit Rot	*Colletotrichum acutatum*	Strawberries #1	KAK-2016-SBerry-MI	MI	Oso	7	6 - 9	6.5	25	NA	Field: 80	4-day post-harvest: 273	Preventative	No	27.0	No	PDMR (Planned fall 2018) (Permission)	New data.
								13	50	NA	85	233						
	Colletotrichum acutatum and	Strawberries #2	KAK-2017-SBerry-MI	MI	Oso	5	7 - 14	13	50	NA	4-day post-harvest: 90	NA	Preventative	No	10.0	No	PDMR (Planned fall 2018) (Permission)	New data.
	Colletotrichum dematium							13	50	NA	88	NA			43.0			
							Mean	6.5	25	NA	80	273						
								13	50	NA	88	233						
Gray mold	*Botrytis cinerea*	Strawberries #1	CER-2012-070	CA	CX-10440	5	7 - 8	3.75	14	40.22	NA	NA	Preventative and curative	No	17.79	No	Certis data; not published.	
								6.5	25	25.44	NA	NA						
		Strawberries #2	CER-2014-038	FL	Oso	14	7	6.5	25	NA	27.2	28.1	Preventative and curative	No	49.5	No	PDMR 9:SMF020	
		Strawberries #3	Adaskaveg, 2013	CA	Tavano	NR	NR	NR	NR	Moder-ate and Vari-able	NA	NA	Not reported	NR	NR	NR	Internet (Adaskaveg)	
		Strawberries #4	KAK-2016-SBerry-MD	MD	Oso	9	5 - 8	6.5	25	NA	61.1	-1.88	Preventative	No	14.4	No	PDMR 11:SMF020	New data. No soil fumigation.
								13	50	NA	69.4	18.5						
		Strawberries #5	KAK-2016-SBerry-MI	MI	Oso	7	6 - 9	6.5	25	NA	85	4-day post-harvest: 273	Preventative	No	39.0	No	PDMR (Planned fall 2018 publication) (Permission)	New data.
								13	50	NA	86	233						
		Strawberries #6	KAK-2017-SBerry-MI	MI	Oso	5	7 - 14	13	50	NA	94	4-day post-harvest: 2350	Preventative	No	53.5	No	PDMR (Planned fall 2018 publication) (Permission)	New data.
							Mean	3.75	14	40.2	NA	NA						
								6.5	25	NA	43	15						
								13	50	NA	90	4-day post-harvest: 1292						

Cumulative Summary of the Efficacy of the Polyoxin D Zinc Salt 5SC Suspension Concentrate Fungicide (EPA Reg. No. 68173-4) and Oso 5%SC Fungicide (EPA Reg. No. 68173-4-70051) Applied as a Foliar Spray to Growing Food Crops Using Ground Application Equipment

Disease	Pathogen	Crop Tested & Sequence No.	Trial No.	State	Formulation [1]	No. App.	Application Interval (Days)	Application Rate		Mean Control (%)		Mean Yield Increase (%)	Application Type(s)	Inoculated?	Max. Pest Pressure in UTC (%)	Phyto-tox ?	Publication Status	Notes
								fl oz/ acre	g a.i./ ha	Leaves	Fruit							
Leather rot	*Phytophthora cactorum*	Strawberries #1	KAK-2016-SBerry-MI	MI	Oso	7	6 - 9	6.5	25	NA	84	4-day post-harvest: 273	Preventative	No	31.0	No	PDMR (Planned fall 2018 publication) (Permission)	New data.
								13	50	NA	98	233						
		Strawberries #2	KAK-2017-SBerry-MI	MI	Oso	5	7 - 14	13	50	NA	81	4-day post-harvest: 2350	Preventative	No	56.8	No	PDMR (Planned fall 2018 publication; permission)	New data.
							Mean	6.5	25	NA	84	4-day post-harvest: 273						
								13	50	NA	90	1292						
Phomopsis Leaf Spot and Fruit Rot	*Phomopsis obscurans*	Strawberries #1	KAK-2016-SBerry-MI	MI	Oso	7	6 - 9	6.5	25	98	NA	4-day post-harvest: 240	Preventative	No	39.5	No	PDMR (Planned fall 2018 publication) (Permission)	New data.
								13	50	100	NA	273						
		Strawberries #2	KAK-2017-SBerry-MI	MI	Oso	5	7 - 14	13	50	83	80	4-day post-harvest: 2350	Preventative	No	35.1	No	PDMR (Planned fall 2018 publication) (Permission)	New data.
							Mean	6.5	25	98	NA	4-day post-harvest: 240						
								13	50	92	80	1312						
Powdery mildew	*Sphacelotheca* sp.	Strawberries #1	CER-2013-008	CA	CX-10440	7	7 - 10	6.5	25	94	NA	NA	Preventative and curative	No	70	No	Certis data; not published	
								13	50	80	NA							
		Strawberries #2	CER-2012-070	CA	CX-10440	5	7 - 8	3.75	14	26.31	NA	NA	Preventative and curative	No	100	No	Certis data; not published.	
								6.5	25	23.75	NA							
		Strawberries #3	CER-2013-008	CA	CX-10440	7	6 - 43	6.5	25	93.5	NA	NA	Preventative and curative	No	70	No	Certis data; not published.	
								13	50	80	NA							
							Mean	3.75	14	26.31	NA	NA						
								6.5	25	70	NA	NA						
								13	50	80	NA	NA						

Cumulative Summary of the Efficacy of the Polyoxin D Zinc Salt 5SC Suspension Concentrate Fungicide (EPA Reg. No. 68173-4) and Oso 5%SC Fungicide (EPA Reg. No. 68173-4-70051) Applied as a Foliar Spray to Growing Food Crops Using Ground Application Equipment

Disease	Pathogen	Crop Tested & Sequence No.	Trial No.	State	Formulation [1]	No. App.	Application Interval (Days)	Application Rate		Mean Control (%)		Mean Yield Increase (%)	Application Type(s)	Inocu-lated?	Max. Pest Pressure in UTC (%)	Phyto-tox ?	Publication Status	Notes
								fl oz/ acre	g a.i./ ha	Leaves	Fruit							
CROP GROUP 19: HERBS AND SPICES																		
Downy Mildew	*Peronospora belbahrii*	Basil #1	IND-2015-218	NY	Oso	1	NA	13	50	52	NA	NA	Preventative	No	100	No	PDMR 10:V034	New data.

1. "Veggieturbo 5SC Suspension Concentrate Fungicide" is Kaken's EPA registered brand name for Polyoxin D Zinc Salt 5SC Fungicide.
"Oso 5%SC Fungicide" and "Tavano 5%SC Fungicide" are Certis USA, L.L.C. supplemental distributor brand names for Polyoxin D Zinc Salt 5SC Fungicide.
"CX-10440" is the Certis USA, L.L.C. formulation code for Polyoxin D Zinc Salt 5SC Fungicide.

NR. Not reported.

Preventative and curative: Treatments include at least one application after disease was observed.
Curative: Disease was confirmed to be present before the first treatment was applied.

STEP 2: Identification of OMRI-List Alternative Products, Efficacy Data, Product Hazards, and Restrictions

METHODOLOGY

Polyoxin D Zinc Salt 5SC Formulation
The first row of each table below in highlighted in yellow and is based upon the data from Step 1. Mean percent control values are based upon mean control values for each trial *separately*, then averaged to determine the mean for the available trials for each crop/diseases combination.

Identification of EPA Registered OMRI-Listed Alternative Products for Crop Groups 13 and 19
The initial identification of EPA registered OMRI-listed alternative products, was achieved using the Cornell University Extension documents, when available:

- 2015 Organic Production and IPM Guide for Blueberries;
- 2015 Organic Production and IPM Guide for Grapes;
- 2016 Organic Production and IPM Guide for Raspberries and Blackberries; and
- 2016 Organic Production and IPM Guide for Strawberries.

The final identification was determined via manual inspection of EPA registered labels for OMRI-listed products. There are many "me-too" copper and sulfur products. Some products are possibly omitted, but the commercially most significant products are believed to have been identified.

The manual inspection of each label included confirmation of the label claim (*e.g.*, suppression vs control) for each crop/disease combination included in this petition addendum.

Efficacy data were reviewed and EPA's Pesticide Product Label System was consulted to identify recently EPA registered OMRI-listed products registered for identified uses.

Published Efficacy Data for OMRI-Listed Alternative Products
Plant Disease Management Reports (PDMR) is a low cost, subscription-based, on-line journal for the publication of efficacy trials. It is the journal of choice for most university efficacy researchers.

For each crop/disease combination, searches were conducted for the crop in combination with the disease. Separate searches were conducted for the crop (singular) and the crop (plural). For example, the search criteria for grapes / bunch rot (caused by Botrytis) included:

- "grape" and "Botrytis"; and
- "grapes" and "Botrytis".

Each article was then reviewed to determine if the article is applicable, *i.e.*,

- The trial included an untreated control; *and*
- One or more OMRI-listed EPA registered alternative for the crop/disease (pathogen) combination was included in the trial in the *absence* of other pesticide products.
    - Tank-mixes and treatment programs with other products were *excluded*.
    - Treatments of a single OMRI-listed pesticide product with, *e.g.*, a surfactant or sticker-spreader were *included*.

For each identified relevant Plant Disease Management Reports article and treatment, the data were summarized. Some trials include data for only a single percent control determination, while others contained more, *e.g.*:

- Incidence and severity; and/or
- Leaves and fruit.

For each trial, the *overall* mean (average) percent control was determined.

If the OMRI-listed alternative had *more* disease than the untreated control (treatment failure), then the percent control was reported and calculated as *0% control* instead of a negative percent control. This provided some bias in favor of the OMRI-listed alternatives but helps with visual comparisons of data sets.

Generally, the Plant Disease Management Reports articles report the data for only one trial location. When more than one trial location is reported in a single article, as in most of the articles regarding cranberries, *each trial location was treated separately* for the calculation of trial averages.

When an OMRI-listed alternative product was evaluated in more then one trial, the average percent control was determined used the *average* percent control for *each* trial. This gives equal weight to each trial and does not favor trials for which more data points were reported.

The mean percent control values are paired with the number of trials included in the calculation of the mean. Mean percent control values supported by a larger number of trials provide greater confidence to the calculated mean. Also higher mean values supported by a larger number of trials reflect greater *consistency* of disease control.

Efficacy Data for the Polyoxin D Zinc Salt 5SC Formulation

For efficacy trials of the polyoxin D zinc salt 5SC formulation (a.k.a. Oso), the selection criteria and method of calculation of averages were the same as above with the *exception* that *all* available data are considered, *i.e.*, published and unpublished data are included in the May 31, 2016 petition or this addendum. An example of included unpublished efficacy data are data from blueberry and raspberry trials that were developed by private (non-university affiliated) researchers.

Comparison of Average Percent Control

The average percent control for the polyoxin D zinc salt 5SC formulation and for the OMRI-listed alternatives are included in the summary tables below. To facilitate comparisons, the average percent control columns are color coded:

- *Green* indicates that the OMRI-listed alternative has similar, equal, or greater average percent control compared to Oso.
- *Orange* indicates that the OMRI-listed alternative provides less than similar percent control compared to Oso but generally more that 50% of the percent control provided by Oso.
- *Red* indicates that the OMRI-listed alternative provides substantially less control than Oso (0% control to approximately 50% of the control provided by Oso).
- *Brown* indicates that no relevant data were found in Plant Disease Management Reports.

Comparison of Hazards and Restrictions

Human and environmental hazard statements on the EPA registered label are summarized. Please note that products that are exempt from regulation as a pesticide under section 25(b) of FIFRA do not have uniform criteria for labels statements. Nonetheless, statements have been summarized based upon the commercial label. The statements are color coded:

- *Red* indicates:
  - EPA's highest hazard categories (*e.g.*, permanent injury);
  - EPA's highest environmental hazard category ("highly toxic"); and
  - Physical hazards that can result in injury (*e.g.*, fire).
- *Orange* indicates:
  - EPA's next most hazardous category for humans (*e.g.*, severe but not permanent injury); and
  - EPA's next most hazardous category for environmental hazards ("toxic").
- *Blue* indicates critical temperature restrictions for use and/or storage for products with a live microorganism as the active ingredient. Please see the product label for details.

OMRI-Listed Product Comparison Table Header Row

OMRI-listed product comparison table header rows have a color background. There is *no meaning* to the color. Instead, the color is included as a visual clue to indicate a new table when the color is different. The color helps to visually link the summarized efficacy data with the corresponding list of OMRI-listed alternative products and the associated crop/disease combination.

OMRI-LISTED ALTERNATIVES: CROP GROUP 13: BERRIES AND SMALL FRUITS: BLUEBERRIES / Alternaria Fruit Rot (*Alternaria* spp.)

Comparative Overview of Efficacy, Hazards, and Use Restrictions
Crop Group 13: Berries and Small Fruits: Blueberries / Alternaria Fruit Rot (*Alternaria* spp.)

NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Synthetic	19	Polyoxin D zinc salt	Oso	68173-4	41	1	See Oso efficacy summary table.	Control.	0	4	None.	May cause dermal sensitization. [F]	Moderately toxic to fish and aquatic invertebrates.	None.
Non-synthetic	44	*Bacillus amylo-liquefaciens* strain MBI 600	Serifel	71840-18	No data	NA	NA	Control. Preventative only. Not for use in California.	0	4	None.	Moderate eye irritation. Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	None.
Non-synthetic	44	*Bacillus pumilus* strain QST 2808	Sonata	264-1153	No data	NA	NA	Control. Preventative only.	0	4	None.	Harmful if inhaled. May cause dermal sensitization. [F] Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Spray solution pH restrictions.
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Optiva	264-1160	No data	NA	NA	Control. Preventative only.	0	4	None.	Moderate eye irritation. May cause dermal sensitization. [F]	None.	None.
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade ASO	264-1152	No data	NA	NA	Control. Preventative only.	0	4	None.	Harmful if inhaled.	None.	None.
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade Max	264-1151	No data	NA	NA	Control. Preventative only.	0	4	None.	May cause dermal sensitization. [F]	None.	None.
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade Optimum	264-1160	No data	NA	NA	Suppression only. Preventative only.	0	4	None.	May cause dermal sensitization. [F]	None.	None.
Non-synthetic	P5	*Reynoutria sachalinensis* extract	Regalia	84059-3	No data	NA	NA	Control. Preventative only.	0	4	None.	Moderate eye irritation.	None.	Avoid freezing.

Comparative Overview of Efficacy, Hazards, and Use Restrictions
Crop Group 13: Berries and Small Fruits: Blueberries / Alternaria Fruit Rot (*Alternaria* spp.)

NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Non-synthetic	NC; Biological	*Streptomyces lydicus* WYEC 108	Actinovate AG	73314-1	No data	NA	NA	Alternaria claim. Mix-and-match directions for use. [E] No specific crop/disease claims. Field uses: Control vs suppression only is not specified. Greenhouse uses: Suppression only.	0	1 or until dry	None.	Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Live bacterium. Use and storage temperature restrictions.
Non-synthetic	NC; Botanical oil	Neem oil	Trilogy	70051-2	No data	NA	NA	Alternaria control claim. Mix-and-match directions for use. [E] No specific crop/disease claims.	0	4	Yes.	Moderate eye irritation.	Toxic to fish, aquatic organisms, and bees.	Use and storage temperature restrictions.
Synthetic	NC; Oxidizing agent	Hydrogen dioxide, Peroxyacetic acid	Oxidate 2.0	70299-2	No data	NA	NA	Control.	0	Until dry	None.	Irreversible eye damage. May be fatal if swallowed. Skin irritation.	Highly toxic to bees and other beneficial insects. Toxic to fish.	Chemical instabilities. Strong oxidizing agent. Use and storage temperature restrictions.

A. FRAC = Fungicide Resistance Action Committee. Products with the same mode of action have the same FRAC Code. NC = Not classified; no FRAC code has been assigned.
B. For Polyoxin D zinc salt (Oso), from summarizes trials, published and unpublished. For OMRI-listed alternatives, from Plant Disease Management Reports (PDMR).
C. Number of trials included in the calculation of the mean.
D. PDMR = Plant Disease Management Reports (on-line journal generally used for publication of efficacy research conducted at universities). Preceded by F&N = Fungicides and Nematicides. https://www.plantmanagementnetwork.org/pub/trial/pdmr/
E. Mix-and-match directions for use. Label has a list of crops and a separate list of diseases with no claim for specific crop/disease combinations.
F. Complete label statement: Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals.
G. EPA relative environmental toxicity descriptors, lowest toxicity to highest toxicity: Practically non-toxic < Moderately toxic < Toxic < Highly toxic.

OMRI-LISTED ALTERNATIVES: CROP GROUP 13: BERRIES: BLUEBERRIES / Botrytis Blight (*Botrytis cinerea*)

Comparative Overview of Efficacy, Hazards, and Use Restrictions
Crop Group 13: Berries and Small Fruits: Blueberries / Botrytis Blight (*Botrytis cinerea*)

NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Synthetic	19	Polyoxin D zinc salt	Oso	68173-4	80	1	See Oso efficacy summary table.	Control.	0	4	None.	May cause dermal sensitization. [F]	Moderately toxic to fish and aquatic invertebrates.	None.
Non-synthetic	44	*Bacillus amylo-liquefaciens* strain D747	Double Nickel 55	70051-108	No data	NA	NA	Control. Preventative only.	0	4	None.	Moderate eye irritation. May cause dermal sensitization. [F]	None.	Water pH restrictions.
Non-synthetic	44	*Bacillus amylo-liquefaciens* strain D747	Double Nickel LC	70051-114	58	1	5:SMF027	Control. Preventative only.	0	4	None.	Moderate eye irritation. May cause dermal sensitization. [F]	None.	Water pH restrictions.
Non-synthetic	44	*Bacillus amylo-liquefaciens* strain F727	Stargus	84059-28	No data			Control. Preventative only.	0	4	None.	Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Not for sale or use after 18 months from the date of manufacture. Avoid freezing.
Non-synthetic	44	*Bacillus amylo-liquefaciens* strain MBI 600	Serifel	71840-18	No data	NA	NA	Control. Preventative only. Not for use in California.	0	4	None.	Moderate eye irritation. Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	None.
Non-synthetic	44	*Bacillus pumilus* strain QST 2808	Sonata	264-1153	No data	NA	NA	Control. Preventative only.	0	4	None.	Harmful if inhaled. May cause dermal sensitization. [F] Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Spray solution pH restrictions.
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Optiva	264-1160	No data	NA	NA	Control. Preventative only.	0	4	None.	Moderate eye irritation. May cause dermal sensitization. [F]	None.	None.
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade ASO	264-1152	No data	NA	NA	Control. Preventative only.	0	4	None.	Harmful if inhaled.	None.	None.
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade Max	264-1151	28	1	5:SMF001	Control. Preventative only.	0	4	None.	May cause dermal sensitization. [F]	None.	None.

Comparative Overview of Efficacy, Hazards, and Use Restrictions
Crop Group 13: Berries and Small Fruits: Blueberries / Botrytis Blight (*Botrytis cinerea*)

NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade Optimum	264-1160	No data	NA	NA	Control. Preventative only.	0	4	None.	Moderate eye irritation. May cause dermal sensitization. [F]	None.	None.
Non-synthetic	P5	*Reynoutria sachalinensis* extract	Regalia	84059-3	0	1	7:SMF031	Control. Preventative only.	0	4	None.	Moderate eye irritation.	None.	Avoid freezing.
Non-synthetic	NC; Biological	*Aureobasidium pullulans* strains DSM 14940 and DSM 14941	Botector	86174-3	No data	NA	NA	Control. Preventative only.	0	4	None.	Harmful if swallowed or absorbed through skin. May cause dermal sensitization. [F] Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Live yeast-like fungus. Use and storage temperature restrictions. Not compatible with many fungicides.
Non-synthetic	NC; Biological	*Streptomyces lydicus* WYEC 108	Actinovate AG	73314-1	No data	NA	NA	Botrytis claim. Mix-and-match directions for use. [E] No specific crop/disease claims. Field uses: Control vs suppression only is not specified. Greenhouse uses: Suppression only.	0	1 or until dry	None.	Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Live bacterium. Use and storage temperature restrictions.
Non-synthetic	NC; Botanical oil	Neem oil	Trilogy	70051-2	No data	NA	NA	Botrytis control claim. Mix-and-match directions for use. [E] No specific crop/disease claims.	0	4	Yes.	Moderate eye irritation.	Toxic to fish, aquatic organisms, and bees.	Use and storage temperature restrictions.
Non-synthetic	NC; Botanical oil	Rosemary oil, Clove oil, Thyme oil	Sporatec	NA; 25(b)	No data	NA	NA	Control.	0	0	Yes.	Harmful if swallowed.	Toxic to bees.	Not for use near heat or open flames.
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Agricure	70870-1	No data	NA	NA	Botrytis control claim. Mix-and-match directions for use. [E] No specific crop/disease claims.	0	1	None.	Harmful if swallowed. Moderate eye irritation.	None.	Mild alkaline solution; tank-mix restrictions.

Comparative Overview of Efficacy, Hazards, and Use Restrictions
Crop Group 13: Berries and Small Fruits: Blueberries / Botrytis Blight (*Botrytis cinerea*)

NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Synthetic	NC; Inorganic salt	Potassium bicarbonate	EcoMate Armicarb O	5905-541	No data	NA	NA	Control.	0	4	None.	Harmful if swallowed. Moderate eye irritation.	None.	Avoid contamination by pesticides and fertilizers. Final spray solution must have pH ≥7.0.
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Milstop	70870-1-68539	No data	NA	NA	Botrytis control claim. Mix-and-match directions for use. [E] No specific crop/disease claims.	0	1	None.	Harmful if swallowed. Moderate eye irritation.	None.	Mild alkaline solution; tank-mix restrictions.
Synthetic	NC; Inorganic salt	Potassium silicate	Sil-Matrix	82100-1	No data	NA	NA	Control.	0	4	None.	Moderate eye irritation	None.	Damages glass surfaces. Chemical instabilities.
Synthetic	NC; Oxidizing agent	Hydrogen dioxide, Peroxyacetic acid	Oxidate 2.0	70299-2	No data	NA	NA	Control.	0	Until dry	None.	Irreversible eye damage. May be fatal if swallowed. Skin irritation.	Highly toxic to bees and other beneficial insects. Toxic to fish.	Chemical instabilities. Strong oxidizing agent. Use and storage temperature restrictions.
Synthetic	NC; Oxidizing agent	Hydrogen peroxide, Hydrogen dioxide	Perpose Plus	86729-1	No data	NA	NA	Botrytis control claim for all agricultural crops. Preventative only.	0	Until dry	None.	Irreversible eye damage and skin burns. May be fatal if absorbed through skin. Harmful if swallowed.	Toxic to birds, mammals, fish, and aquatic life.	Chemical instabilities. Strong oxidizing agent. Storage restrictions.

A. FRAC = Fungicide Resistance Action Committee. Products with the same mode of action have the same FRAC Code. NC = Not classified; no FRAC code has been assigned.
B. For Polyoxin D zinc salt (Oso), from summarizes trials, published and unpublished. For OMRI-listed alternatives, from Plant Disease Management Reports (PDMR).
C. Number of trials included in the calculation of the mean.
D. PDMR = Plant Disease Management Reports (on-line journal generally used for publication of efficacy research conducted at universities). Preceded by F&N = Fungicides and Nematicides. https://www.plantmanagementnetwork.org/pub/trial/pdmr/
E. Mix-and-match directions for use. Label has a list of crops and a separate list of diseases with no claim for specific crop/disease combinations.
F. Complete label statement: Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals.
G. EPA relative environmental toxicity descriptors, lowest toxicity to highest toxicity: Practically non-toxic < Moderately toxic < Toxic < Highly toxic.

Plant Disease Management Reports citations and data summaries:

7:SMF031. J.W. Pscheidt and J.P. Bassinette, Oregon State University. Fungicide Management of blueberry fruit rots, 2012.
Regalia at 12 gal/A beginning at pre-bloom: No control. Less disease control than the untreated control.

5:SMF001. J.W. Pscheidt and J.P. Bassinette, Oregon State University. Management of *Botrytis* fruit rot and mummy berry, 2010.
Serenade Max at 3 lb/A + Nu-Film-P at 6 fl oz/100 gal/A: 28% control of Botrytis fruit rot.

5:SMF027. J.W. Pscheidt, J.P. Bassinette and L. A. Jones, Oregon State University. Fungicide Management of blueberry fruit rots, 2015.
Double Nickel LC at 2 qt/A, beginning at floral rosette with 1 or 2 open blooms: 70.5% control of Botrytis blight.
Double Nickel LC at 2 qt/A, beginning at floral rosette with 1 or 2 open blooms: 44.9% control of Botrytis blight.
Trial mean: 57.7% control.

OMRI-LISTED ALTERNATIVES: CROP GROUP 13: BERRIES AND SMALL FRUITS: BLUEBERRIES / Mummyberry (*Monilinia vaccinii-corymbosi*)

Comparative Overview of Efficacy, Hazards, and Use Restrictions Crop Group 13: Berries and Small Fruits: Blueberries / Mummyberry (*Monilinia vaccinii-corymbosi*)														
NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Synthetic	19	Polyoxin D zinc salt	Oso	68173-4	64	6	See Oso efficacy summary table.	Control.	0	4	None.	May cause dermal sensitization. [F]	Moderately toxic to fish and aquatic invertebrates.	None.
Non-synthetic	44	*Bacillus amylo-liquefaciens* strain D747	Double Nickel 55	70051-108	No data	NA	NA	Suppression only. Preventative only.	0	4	None.	Moderate eye irritation. May cause dermal sensitization. [F]	None.	Water pH restrictions.
Non-synthetic	44	*Bacillus amylo-liquefaciens* strain D747	Double Nickel LC	70051-114	50	2	10:SMF026; 9:SMF038.	Suppression only. Preventative only.	0	4	None.	Moderate eye irritation. May cause dermal sensitization. [F]	None.	Water pH restrictions.
Non-synthetic	44	*Bacillus amylo-liquefaciens* strain MBI 600	Serifel	71840-18	No data	NA	NA	Control. Preventative only. Not for use in California.	0	4	None.	Moderate eye irritation. Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	None.
Non-synthetic	44	*Bacillus pumilus* strain QST 2808	Sonata ASO	264-1153	No data	NA	NA	Control. Preventative only.	0	4	None.	Harmful if inhaled. May cause dermal sensitization. [F] Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Spray solution pH restrictions.
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Optiva	264-1160	78	1	7:SMF013.	Suppression only. Preventative only.	0	4	None.	Moderate eye irritation. May cause dermal sensitization. [F]	None.	None.
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade ASO	264-1152	21	2	2:SMF013; F&N 59:SMF023	Control. Preventative only.	0	4	None.	Harmful if inhaled.	None.	None.
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade Max	264-1151	41	2	5:SMF001; F&N 61: SMF023.	Control. Preventative only.	0	4	None.	May cause dermal sensitization. [F]	None.	None.
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade Optimum	264-1160	28	3	10:SMF026; 9:SMF038; 8:SMF003.	Suppression only. Preventative only.	0	4	None.	Moderate eye irritation. May cause dermal sensitization. [F]	None.	None.

Comparative Overview of Efficacy, Hazards, and Use Restrictions
Crop Group 13: Berries and Small Fruits: Blueberries / Mummyberry (*Monilinia vaccinii-corymbosi*)

NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Non-synthetic	P5	*Reynoutria sachalinensis* extract	Regalia	84059-3	27	5	8:SMF003; 8:SMF023; 7:SMF005; 7:SMF007; 7:SMF030.	Control. Preventative only.	0	4	None.	Moderate eye irritation.	None.	Avoid freezing.
Non-synthetic	NC; Biological	*Streptomyces lydicus* WYEC 108	Actinovate AG	73314-1	No data	NA	NA	Monilinia claim. Mix-and-match directions for use. [E] No specific crop/disease claims. Field uses: Control vs suppression only is not specified. Greenhouse uses: Suppression only.	0	1 or until dry	None.	Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Live bacterium. Use and storage temperature restrictions.
Non-synthetic	NC; Botanical oil	Clove oil, Rosemary oil, Peppermint oil	BacStop	NA; 25(b)	No data	NA	NA	Control.	0	0	None.	Temporary eye and skin irritation	No FIFRA statements.	Storage temperature restrictions.
Synthetic	NC; Inorganic salt	Potassium bicarbonate	EcoMate Armicarb O	5905-541	No data	NA	NA	Control.	0	4	None.	Harmful is swallowed. Moderate eye irritation.	None.	Avoid contamination by pesticides and fertilizers. Final spray solution must have pH ≥7.0.
Synthetic	NC; Oxidizing agent	Hydrogen dioxide, Peroxyacetic acid	Oxidate 2.0	70299-2	No data	NA	NA	Control.	0	Until dry	None.	Irreversible eye damage. May be fatal if swallowed. Skin irritation.	Highly toxic to bees and other beneficial insects. Toxic to fish.	Chemical instabilities. Strong oxidizing agent. Use and storage temperature restrictions.

A. FRAC = Fungicide Resistance Action Committee. Products with the same mode of action have the same FRAC Code. NC = Not classified; no FRAC code has been assigned.
B. For Polyoxin D zinc salt (Oso), from summarizes trials, published and unpublished. For OMRI-listed alternatives, from Plant Disease Management Reports (PDMR).
C. Number of trials included in the calculation of the mean.
D. PDMR = Plant Disease Management Reports (on-line journal generally used for publication of efficacy research conducted at universities). Preceded by F&N = Fungicides and Nematicides. https://www.plantmanagementnetwork.org/pub/trial/pdmr/
E. Mix-and-match directions for use. Label has a list of crops and a separate list of diseases with no claim for specific crop/disease combinations.
F. Complete label statement: Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals.
G. EPA relative environmental toxicity descriptors, lowest toxicity to highest toxicity: Practically non-toxic < Moderately toxic < Toxic < Highly toxic.

Comparative Overview of Efficacy, Hazards, and Use Restrictions Crop Group 13: Berries and Small Fruits: Blueberries / Mummyberry (*Monilinia vaccinii-corymbosi*)														
NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical

Plant Disease Management Reports citations and data summaries:

10:SMF026. J.W. Pscheidt, J.P. Bassinette, and S. Heckert, Oregon State University. Evaluation of various fungicides for management of mummy berry, 2015.
Double Nickel LC at 2 qt/A beginning at floral bud break (8 applications): No control of floral strikes, vegetative strikes and mummyberries (less disease control than untreated control).
Serenade Opti at 20 oz/A beginning at floral bud break (8 applications): 9.9% control of floral strikes. No control of vegetative strikes (less disease control than untreated control). 8.9% control of mummyberries. Trial mean: 6.3% control (n = 3).

9:SMF038. A. M.C. Schilder, J. M. Gillett, and W. Sysaks, Michigan State University. Evaluation of fungicides and biocontrol products for control of mummy berry in blueberries, 2014.
Serenade Optimum at 20 oz/A + NuFilm P at 0.125% (v/v) beginning at green tip, apothecia present: 66% control of shoot strikes. 42% control on fruit. Trial mean: 54% control (n = 2).
Double Nickel LC at 1.06 qt/A beginning at green tip, apothecia present: 100% control of shoot strikes. 98% control on fruit.
Double Nickel LC at 2.1 qt/A beginning at green tip, apothecia present: 100% control of shoot strikes. 100% control on fruit. Trial mean: 99.5% control (n = 4).

8:SMF003. J.W. Pscheidt, J.P. Bassinette, and J. Florance, Oregon State University. Evaluation of various products for management of mummy berry, 2013.
Serenade Optimum at 16 oz/A + Nu-Film-P at 32 fl oz/100 gal/A beginning at floral bud break: 35% control of floral strikes and 10% control on fruit. Trial mean: 22.5% control (n = 2).
Regalia at 1 gal/A beginning at floral bud break: 43% control of floral strikes and 38% control on fruit. Trial mean = 40.5% control (n = 2).

8:SMF023. F. Connelly, Univ. of Georgia. Mummy berry management in rabbiteye blueberry with chemical and organic fungicides, 2013.
Regalia at 4 qt/A beginning at green tip: 0.7% control of mummyberry incidence.

7:SMF005. W. O. Cline and B. K. Bloodworth, North Carolina State University. Fungicides for mummy berry and blueberry rust control on 'Rebel' in North Carolina, 2012.
Regalia at 2 qt/A beginning March 16, 2012: 3% control of mummyberries per bush.

7:SMF007. W. O. Cline and B. K. Bloodworth, North Carolina State University. Fungicides for mummy berry control on 'Powderblue', 'Vernon' and 'Ochlockonee' in North Carolina, 2012.
Regalia at 2 Qt/A: Average 36% (range 14% to 50%) control of number of shoot strikes.

7:SMF013. A.M.C. Schilder, J. M. Gillett, and W. Sysaks, Michigan State University. Evaluating fungicides and biocontrol products for control of mummyberry in blueberries, 2012.
Optiva at 1 lb/A + Nu Film P at 0.25%(v/v) beginning at pink bud: 79.0% control of shoot strikes and 76.3% control of mummies. Trial mean: 77.7% control (n = 2).

7:SMF030. J.W. Pscheidt and J.P. Bassinette, Oregon State University. Evaluation of materials for management of mummy berry, 2012.
Regalia at 1 gal/A beginning at floral bud break: 71% control of floral strikes. 58% control of vegetative strikes. 29% control on fruit. Trial mean: 52.7% control (n = 3).

5:SMF001. J.W. Pscheidt and J.P. Bassinette, Oregon State University. Management of *Botrytis* fruit rot and mummy berry, 2010.
Serenade Max at 3 lb/A + Nu-Film-P at 6 fl oz/100 gal/A: 19% control of mummy berry floral and vegetative strikes. 19% control of mummy berry fruit rot. Trial mean: 19% control (n = 2).

2:SMF013. J.W. Pscheidt and J.P. Bassinette, Oregon State University. Fungicidal control of mummy berry, 2007
Serenade ASO at 256 fl oz/A beginning at floral bud break: 28% control on floral clusters. 8% control on shoots. No control on green fruit (less effective than untreated control). Trial mean: 12% control (n = 3).

F&N Vol 61: SMF023. A.M.C. Schilder, J. M. Gillett, and W. Sysaks, Michigan State University. Evaluation of fungicides for control of mummy berry in 'Rubel' blueberries, 2005.
Serenade Max at 3 lb/A beginning at green tip: 95% control of shoot strikes. 31% control on fruit. Trial mean: 63% control (n = 2).

F&N Vol 59:SMF023. A.M.C. Schilder, J. M. Gillett, and W. Sysaks, Michigan State University. Evaluation of fungicides for control of mummy berry in blueberries, 2003.
Serenade (formulation and rate not specified; ASO assumed) beginning at early green tip: 16% control of shoot strikes. 45% control on fruit. Trial mean: 30.5% control (n = 2).

OMRI-LISTED ALTERNATIVES: CROP GROUP 13: BERRIES AND SMALL FRUITS: CANEBERRIES / Botrytis Fruit Rot (*Botrytis cinerea*) (add citations)

Comparative Overview of Efficacy, Hazards, and Use Restrictions Crop Group 13: Berries and Small Fruits: Caneberries / Botrytis Fruit Rot (*Botrytis cinerea*)														
NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Synthetic	19	Polyoxin D zinc salt	Oso	68173-4	65	3	See Oso efficacy summary table.	Control.	0	4	None.	May cause dermal sensitization. [F]	Moderately toxic to fish and aquatic invertebrates.	None.
Non-synthetic	44	Bacillus amylo-liquefaciens strain D747	Double Nickel 55	70051-108	No data	NA	NA	Control. Preventative only.	0	4	None.	Moderate eye irritation. May cause dermal sensitization. [F]	None.	Water pH restrictions.
Non-synthetic	44	*Bacillus amylo-liquefaciens* strain MBI 600	Serifel	71840-18	No data	NA	NA	Control. Preventative only. Not for use in California.	0	4	None.	Moderate eye irritation. Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	None.
Non-synthetic	44	*Bacillus pumilus* strain QST 2808	Sonata	264-1153	No data	NA	NA	Control. Preventative only.	0	4	None.	Harmful if inhaled. May cause dermal sensitization. [F] Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Spray solution pH restrictions.
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade ASO	264-1152	14	4	F&N 58:SMF048; F&N 57;SMF31; F&N 57:SMF32; F&N 56:SMF38.	Control. Preventative only.	0	4	None.	Harmful if inhaled.	None.	None.
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade Max	264-1151	No data	NA	NA	Control. Preventative only.	0	4	None.	May cause dermal sensitization. [F]	None.	None.
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade Optimum	264-1160	No data	NA	NA	Suppression only. Preventative only.	0	4	None.	May cause dermal sensitization. [F]	None.	None.
Non-synthetic	P5	*Reynoutria sachalinensis* extract	Regalia	84059-3	37	1	7:SMF008	Control. Preventative only.	0	4	None.	Moderate eye irritation.	None.	Avoid freezing.

Comparative Overview of Efficacy, Hazards, and Use Restrictions Crop Group 13: Berries and Small Fruits: Caneberries / Botrytis Fruit Rot (*Botrytis cinerea*)														
NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Non-synthetic	NC; Bio-chemical	Rhamnolipid biosurfactant	Zonix	72431-1	23	1	8:V2017	Botrytis control claim. Mix-and-match directions for use. [E] No specific crop/disease claims. Preventative use only.	0	4	None.	Irreversible eye damage.	None.	Do not use at ambient temperatures over 80°F. Keep from overheating or freezing. Store out of direct sunlight.
Non-synthetic	NC; Biological	*Aureobasidium pullulans* strains DSM 14940 and DSM 14941	Botector	86174-3	No data	NA	NA	Control. Preventative only.	0	4	None.	Harmful if swallowed or absorbed through skin. May cause dermal sensitization. [F] Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Live yeast-like fungus. Use and storage temperature restrictions. Not compatible with many fungicides.
Non-synthetic	NC; Biological	*Streptomyces lydicus* WYEC 108	Actinovate AG	73314-1	7	1	2:SMF003	Botrytis claim. Mix-and-match directions for use. [E] No specific crop/disease claims. Field uses: Control vs suppression only is not specified. Greenhouse uses: Suppression only.	0	1 or until dry	None.	Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Live bacterium. Use and storage temperature restrictions.
Non-synthetic	NC; Botanical oil	Neem oil	Trilogy	70051-2	No data	NA	NA	Botrytis control claim. Mix-and-match directions for use. [E] No specific crop/disease claims.	0	4	Yes.	Moderate eye irritation.	Toxic to fish, aquatic organisms, and bees.	Temperature restrictions. Storage restrictions.
Non-synthetic	NC; Botanical oil	Rosemary oil, Clove oil, Thyme oil	Sporatec	NA; 25(b)	No data	NA	NA	Control.	0	0	Yes.	Harmful if swallowed.	Toxic to bees.	Not for use near heat or open flames.

Comparative Overview of Efficacy, Hazards, and Use Restrictions Crop Group 13: Berries and Small Fruits: Caneberries / Botrytis Fruit Rot (*Botrytis cinerea*)														
NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Synthetic	M1	Copper octanoate	Cueva	67702-2-70051	No data	NA	NA	Control.	0	4	Yes.	Harmful if swallowed or absorbed through skin.	Toxic to fish and aquatic organisms.	Do not store below 4°C (39°F). Tank-mix restrictions.
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Agricure	70870-1	No data	NA	NA	Botrytis control claim. Mix-and-match directions for use. [E] No specific crop/disease claims.	0	1	None.	Harmful if swallowed. Moderate eye irritation.	None.	Mild alkaline solution; tank-mix restrictions.
Synthetic	NC; Inorganic salt	Potassium bicarbonate	EcoMate Armicarb O	5905-541	No data	NA	NA	Control.	0	4	None.	Harmful if swallowed. Moderate eye irritation.	None.	Avoid contamination by pesticides and fertilizers. Final spray solution must have pH ≥7.0.
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Milstop	70870-1-68539	No data	NA	NA	Botrytis control claim. Mix-and-match directions for use. [E] No specific crop/disease claims.	0	1	None.	Harmful if swallowed. Moderate eye irritation.	None.	Mild alkaline solution; tank-mix restrictions.
Synthetic	NC; Oxidizing agent	Hydrogen dioxide, Peroxyacetic acid	Oxidate 2.0	70299-2	9	1	2:SMF003	Control.	0	Until dry	None.	Irreversible eye damage. May be fatal if swallowed. Skin irritation.	Highly toxic to bees and other beneficial insects. Toxic to fish.	Chemical instabilities. Strong oxidizing agent. Use and storage temperature restrictions.

A. FRAC = Fungicide Resistance Action Committee. Products with the same mode of action have the same FRAC Code. NC = Not classified; no FRAC code has been assigned.
B. For Polyoxin D zinc salt (Oso), from summarizes trials, published and unpublished. For OMRI-listed alternatives, from Plant Disease Management Reports (PDMR).
C. Number of trials included in the calculation of the mean.
D. PDMR = Plant Disease Management Reports (on-line journal generally used for publication of efficacy research conducted at universities). Preceded by F&N = Fungicides and Nematicides. https://www.plantmanagementnetwork.org/pub/trial/pdmr/
E. Mix-and-match directions for use. Label has a list of crops and a separate list of diseases with no claim for specific crop/disease combinations.
F. Complete label statement: Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals.
G. EPA relative environmental toxicity descriptors, lowest toxicity to highest toxicity: Practically non-toxic < Moderately toxic < Toxic < Highly toxic.

Comparative Overview of Efficacy, Hazards, and Use Restrictions Crop Group 13: Berries and Small Fruits: Caneberries / Botrytis Fruit Rot (*Botrytis cinerea*)													
NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical

Plant Disease Management Reports citations and data summaries.

7:SMF008. A.M.C. Schilder, J. M. Gillett, and R. W. Sysak, Michigan State University. Evaluation of fungicides for control of foliar and fruit diseases in red raspberries, 2012.
Regalia at 1 qt/acre + Nu Film P at 0.25%: 64% control of post-harvest Botrytis, harvest 1. 21% control of post-harvest Botrytis, harvest 2.
Regalia at 1 qt/acre + Nu Film P at 0.25%: 64% control of post-harvest Botrytis, harvest 1. 15% control of post-harvest Botrytis, harvest 2.
Regalia at 1 qt/acre + Nu Film P at 0.25%: 33% control of post-harvest Botrytis, harvest 1. 17% control of post-harvest Botrytis, harvest 2.
Regalia at 1 qt/acre + Nu Film P at 0.25%: 51% control of post-harvest Botrytis, harvest 1. 33% control of post-harvest Botrytis, harvest 2.
Trial mean: 37% control (n = 8).

2:SMF003. A.M.C. Schilder, J. M. Gillett, and R. W. Sysak, Michigan State University. Evaluation of fungicides for control of fruit diseases of red raspberries, 2007.
Actinovate at 12 oz/acre: 7% control of post-harvest Botrytis fruit rot incidence.
Oxidate at 4 pt/acre: 9% control of post-harvest Botrytis fruit rot incidence.

F&N 58:SMF048. P. R. Bristow and G. E. Windom, Washington State University. Evaluation of fungicides for control of fruit rot and red raspberry, 2002.
Serenade (specific formulation not specified; ASO assumed) at 8.0 lb/acre: 8% control of all fungi (mostly Botrytis), fresh market. 4% control of Botrytis, processing.
Trial mean: 6% control (n = 2).

F&N 57:SMF31. P. R. Bristow and G. E. Windom, Washington State University. Use of fungicides to control fruit diseases of red raspberry, 2001.
Serenade ASO at 2 gal/A: 13% control of Botrytis fruit rot, fresh market. 5% control of Botrytis fruit rot, processing.
Serenade ASO at 2 gal/A: 25% control of Botrytis fruit rot, fresh market. 15% control of Botrytis fruit rot, processing.
Trial mean: 15% control (n = 4).

F&N 57:SMF32. J. DeFrancesco and G. Koskela, Oregon State University. Evaluation of fungicides for control of fruit rot on raspberries, 2001.
Serenade ASO at 1.335 gal/acre: 38% control of Botrytis fruit rot incidence (July 2). 4% control of Botrytis fruit rot incidence (July 9).
Trial mean: 21% control (n = 2).

F&N 56:SMF38. P. R. Bristow and G. E. Windom, Washington State University. Evaluation of fungicides for control of cane and fruit diseases of red raspberry, 1999.
Serenade (specific formulation not specified; ASO assumed) at 8 lb/acre: 7% control of Botrytis fruit rot, fresh market. 16% control of Botrytis fruit rot, post-harvest.
Trial mean: 12% control (n = 2).

OMRI-LISTED ALTERNATIVES: CROP GROUP 13: BERRIES AND SMALL FRUITS: CANEBERRIES / Powdery Mildew (*Podosphaera aphanais*)

Comparative Overview of Efficacy, Hazards, and Use Restrictions Crop Group 13: Berries and Small Fruits: Caneberries / Powdery Mildew (*Podosphaera aphanis*)														
NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Synthetic	19	Polyoxin D zinc salt	Oso	68173-4	74	2	See Oso efficacy summary table.	Control.	0	4	None.	May cause dermal sensitization. [F]	Moderately toxic to fish and aquatic invertebrates.	None.
Non-synthetic	44	*Bacillus amylo-liquefaciens* strain MBI 600	Serifel	71840-18	No data	NA	NA	Control. Preventative only. Not for use in California.	0	4	None.	Moderate eye irritation. Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	None.
Non-synthetic	44	*Bacillus pumilis* strain QST 2808	Sonata ASO	264-1153	No data	NA	NA	Control. Preventative only.	0	4	None.	Harmful if inhaled. May cause dermal sensitization. [F] Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Spray solution pH restrictions.
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade Max	264-1151	No data	NA	NA	Control. Preventative only.	0	4	None.	May cause dermal sensitization. [F]	None.	None.
Non-synthetic	P5	*Reynoutria sachalinensis* extract	Regalia	84059-3	No data	NA	NA	Control. Preventative only.	0	4	None.	Moderate eye irritation.	None.	Avoid freezing.
Non-synthetic	NC; Bio-chemical	Rhamnolipid biosurfactant	Zonix	72431-1	No data			Powdery mildew control claim. Mix-and-match directions for use. [E] No specific crop/disease claims. Preventative use only.	0	4	None.	Irreversible eye damage.	None.	Do not use at ambient temperatures over 80°F. Keep from overheating or freezing. Store out of direct sunlight.

Comparative Overview of Efficacy, Hazards, and Use Restrictions
Crop Group 13: Berries and Small Fruits: Caneberries / Powdery Mildew (*Podosphaera aphanis*)

NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Non-synthetic	NC; Biological	*Streptomyces lydicus* WYEC	Actinovate	73314-1	No data	NA	NA	Powdery mildew claim. Mix-and-match directions for use. [E] No specific crop/disease claims. Field uses: Control vs suppression only is not specified. Greenhouse uses: Suppression only.	0	1 or until dry	None.	Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Live bacterium. Use and storage temperature restrictions.
Non-synthetic	NC; Botanical oil	Neem oil	Trilogy	70051-2	No data	NA	NA	Powdery mildew control claim. Mix-and-match directions for use. [E] No specific crop/disease claims.	0	4	Yes.	Moderate eye irritation.	Toxic to fish, aquatic organisms, and bees.	Temperature restrictions. Storage restrictions.
Non-synthetic	NC; Botanical oil	Cinnamon oil	Cinnerate	NA; 25(b)	No data	NA	NA	Control.	0	0	None.	Eye and skin irritation. May cause dermal sensitization. [F]	None.	Do not expose to light.
Non-synthetic	NC; Botanical oil	Garlic oil, Cottonseed oil, Corn oil	Mildew Cure	NA; 25(b)	No data	NA	NA	General powdery mildew claim; not crop specific.	0	0	None.	Avoid contact with skin, eyes, and clothing.	No FIFRA statement.	None.
Non-synthetic	NC; Botanical oil	Rosemary oil, Clove oil, Thyme oil	Sporatec	NA; 25(b)	No data	NA	NA	Control.	0	0	Yes.	Harmful if swallowed.	Toxic to bees.	Not for use near heat or open flames.
Non-synthetic	NC; Organic acid	Citric acid	Nuke Em	NA; 25(b)	No data	NA	NA	General mildew claim; not crop specific.	0	0	None.	No FIFRA statement.	No FIFRA statement.	Store away from direct sunlight.
Synthetic	M2	Sulfur	Acoidal	62562-4	No data	NA	NA	Control.	0	24	Yes.	Harmful if swallowed, inhaled, or absorbed through skin.	Toxic to fish and aquatic organisms.	Suspended dust ignites easily.
Synthetic	M2	Sulfur	Cosavet-DF	70905-1	No data	NA	NA	Control.	0	24	Yes.	Harmful if swallowed, inhaled, or absorbed through skin. Moderate eye irritation.	None.	Suspended dust ignites easily.
Synthetic	M2	Sulfur	Defend DF	62562-8	No data	NA	NA	Control.	0	24	Yes.	Harmful if swallowed, inhaled, or absorbed through skin.	Toxic to fish and aquatic organisms.	Suspended dust ignites easily.

Comparative Overview of Efficacy, Hazards, and Use Restrictions Crop Group 13: Berries and Small Fruits: Caneberries / Powdery Mildew (*Podosphaera aphanis*)														
NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Synthetic	M2	Sulfur	Kumulus DF	51306-352-66330	No data	NA	NA	Control.	0	24	Yes.	Harmful if swallowed. Avoid contact with eyes, skin, and clothing.	None.	Do not store above 104°F.
Synthetic	M2	Sulfur	Micro Sulf	55146-75	No data	NA	NA	Control.	0	24	Yes.	Harmful if swallowed, inhaled, or absorbed through skin. Eye irritation.	None.	Keep away from heat, sparks, or flames.
Synthetic	M2	Sulfur	Microthiol Disperss	70506-187	No data	NA	NA	Control.	0	24	Yes.	Harmful if swallowed, inhaled, or absorbed through skin.	None.	Do not store near flammable materials.
Synthetic	M2	Sulfur	Thiolux	34704-1079	No data	NA	NA	Control.	0	24	Yes.	Harmful if swallowed, inhaled, or absorbed through skin. Eye irritation.	None.	Suspended dust ignites easily.
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Agricure	70870-1	No data	NA	NA	Powdery mildew control claim. Mix-and-match directions for use. [E] No specific crop/disease claims.	0	1	None.	Harmful if swallowed. Moderate eye irritation.	None.	Mild alkaline solution; tank-mix restrictions.
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Kaligreen	70231-1	No data	NA	NA	General powdery mildew control claim.	1	4	None.	Harmful if swallowed.	None.	Chemical incompatibilities.
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Milstop	70870-1-68539	No data	NA	NA	Powdery mildew control claim. Mix-and-match directions for use. [E] No specific crop/disease claims.	0	1	None.	Harmful if swallowed. Moderate eye irritation.	None.	Mild alkaline solution; tank-mix restrictions.
Synthetic	NC; Inorganic salt	Potassium bicarbonate	EcoMate Armicarb O	5905-541	No data	NA	NA	Control.	0	4	None.	Harmful if swallowed. Moderate eye irritation.	None.	Avoid contamination by pesticides and fertilizers. Final spray solution pH must be ≥7.0.
Synthetic	NC; Inorganic salt	Potassium silicate	Sil-Matrix	82100-1	No data	NA	NA	General powdery mildew control claim. Preventative only.	0	4	None.	Moderate eye irritation.	None	Chemical incompatibilities.
Synthetic	NC; Organic salt	Potassium salts of fatty acids	M-Pede	10163-324	No data	NA	NA	Control.	0	12	Yes.	Substantial eye injury. Skin irritation.	Harmful to aquatic invertebrates	If water has high mineral content, check for compatibility.

Comparative Overview of Efficacy, Hazards, and Use Restrictions Crop Group 13: Berries and Small Fruits: Caneberries / Powdery Mildew (*Podosphaera aphanis*)														
NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Synthetic	NC; Organic salt	Insecticidal soap	Des-X	67702-22-70051	No data	NA	NA	Control.	0	12	Yes.	Substantial eye injury. Skin irritation.	Harmful to aquatic invertebrates	If water has high mineral content, check for compatibility.
Synthetic	NC; Oxidizing agent	Hydrogen dioxide, Peroxyacetic acid	Oxidate	70299-2	No data	NA	NA	Control.	0	Until dry	None.	Irreversible eye damage. May be fatal if swallowed. Skin irritation.	Highly toxic to bees and other beneficial insects. Toxic to fish.	Chemical instabilities. Strong oxidizing agent. Use and storage temperature restrictions.
Synthetic	NC; Oxidizing agent	Hydrogen peroxide, Hydrogen dioxide	Perpose Plus	86729-1	No data	NA	NA	Powdery mildew control claim for all agricultural crops. Preventative only.	0	Until dry	None.	Irreversible eye damage and skin burns. May be fatal if absorbed through skin. Harmful if swallowed.	Toxic to birds, mammals, fish, and aquatic life.	Chemical instabilities. Strong oxidizing agent. Storage restrictions.
Synthetic	NC; Petroleum oil	Mineral oil	Glacial Spray Liquid	34704-849	No data	NA	NA	Control.	0	4	Yes (with sulfur).	Harmful if swallowed, inhaled, or absorbed through skin. Eye irritation. May cause dermal sensitization. [F]	Hazardous to aquatic organisms.	None.
Synthetic	NC; Petroleum oil	Mineral oil	JMS Stylet Oil	65564-1	No data	NA	NA	Control.	0	4	Yes (with sulfur).	Harmful if swallowed.	Toxic to fish.	None.
Synthetic	NC; Petroleum oil	Mineral oil	Omni Supreme Spray	5905-368	No data	NA	NA	Control.	0	12	Yes (with sulfur).	Harmful if absorbed through skin. May cause dermal sensitization. [F]	Toxic to fish and aquatic organisms.	Chemical incompatibilities.
Synthetic	NC; Petroleum oil	Mineral oil	PureSpray Green	69526-9	No data	NA	NA	Control.	0	4	Yes (with sulfur).	Harmful if swallowed or absorbed through skin. May cause dermal sensitization. [F]	Toxic to aquatic organisms.	None.
Synthetic	NC; Petroleum oil	Mineral oil	TriTek	48813-1	No data	NA	NA	Control.	0	4	Yes (with sulfur).	Harmful if swallowed or absorbed through skin. May cause dermal sensitization. [F]	Toxic to aquatic organisms.	None.
Synthetic	NC; Petroleum oil	Aliphatic petroleum solvent	SuffOil-X	48813-1-68539	No data	NA	NA	Control.	0	4	Yes (with sulfur).	Harmful if swallowed. May cause dermal sensitization. [F]	Toxic to aquatic organisms.	None.

Comparative Overview of Efficacy, Hazards, and Use Restrictions
Crop Group 13: Berries and Small Fruits: Caneberries / Powdery Mildew (*Podosphaera aphanis*)

NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical

A. FRAC = Fungicide Resistance Action Committee. Products with the same mode of action have the same FRAC Code. NC = Not classified; no FRAC code has been assigned.
B. For Polyoxin D zinc salt (Oso), from summarizes trials, published and unpublished. For OMRI-listed alternatives, from Plant Disease Management Reports (PDMR).
C. Number of trials included in the calculation of the mean.
D. PDMR = Plant Disease Management Reports (on-line journal generally used for publication of efficacy research conducted at universities). Preceded by F&N = Fungicides and Nematicides.
https://www.plantmanagementnetwork.org/pub/trial/pdmr/
Search terms included raspberry, raspberries, blackberry, blackberries, caneberry, and caneberries in combination with “powdery mildew”.
E. Mix-and-match directions for use. Label has a list of crops and a separate list of diseases with no claim for specific crop/disease combinations.
F. Complete label statement: Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals.
G. EPA relative environmental toxicity descriptors, lowest toxicity to highest toxicity: Practically non-toxic < Moderately toxic < Toxic < Highly toxic.
D. Serenade formulation not specified.

OMRI-LISTED ALTERNATIVES: CROP GROUP 13: BERRIES AND SMALL FRUITS: CRANBERRIES / Cottonball (*Monilinia oxycocci*)

There are no OMRI-listed products that are EPA registered for use on cranberries for treatment of cottonball.

Comparative Overview of Efficacy, Hazards, and Use Restrictions
Crop Group 13: Berries and Small Fruits: Cranberries / Cottonball (*Monilinia oxycocci*)

NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Synthetic	19	Polyoxin D zinc salt	Oso	68173-4	46	5	See Oso efficacy summary table.	Control.	0	4	None.	May cause dermal sensitization. [F]	Moderately toxic to fish and aquatic invertebrates.	None.

A. FRAC = Fungicide Resistance Action Committee. Products with the same mode of action have the same FRAC Code. NC = Not classified; no FRAC code has been assigned.
B. For Polyoxin D zinc salt (Oso), from summarizes trials, published and unpublished. For OMRI-listed alternatives, from Plant Disease Management Reports (PDMR).
C. Number of trials included in the calculation of the mean.
D. PDMR = Plant Disease Management Reports (on-line journal generally used for publication of efficacy research conducted at universities). Preceded by F&N = Fungicides and Nematicides. https://www.plantmanagementnetwork.org/pub/trial/pdmr/
E. Mix-and-match directions for use. Label has a list of crops and a separate list of diseases with no claim for specific crop/disease combinations.
F. Complete label statement: Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals.
G. EPA relative environmental toxicity descriptors, lowest toxicity to highest toxicity: Practically non-toxic < Moderately toxic < Toxic < Highly toxic.

OMRI-LISTED ALTERNATIVES: CROP GROUP 13: BERRIES: CRANBERRIES / Fruit Rot Complex (*Coleophoma empetri*, *Colletotrichum acutatum*, *Colletotrichum gloeosporioides*, *Phyllosticta vaccinii*, and *Physalospora vaccinii*, etc.)

Comparative Overview of Efficacy, Hazards, and Use Restrictions
Crop Group 13: Berries and Small Fruits: Cranberries / Fruit Rot Complex
(*Coleophoma empetri*, *Colletotrichum acutatum*, *Colletotrichum gloeosporioides*, *Phyllosticta vaccinii*, and *Physalospora vaccinii*, etc.)

NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Synthetic	19	Polyoxin D zinc salt	Oso	68173-4	65	10	See Oso efficacy summary table.	Control (most pathogens).	0	4	None.	May cause dermal sensitization. [F]	Moderately toxic to fish and aquatic invertebrates.	None.
Synthetic	M1	Copper hydroxide	Nu-Cop 50 WP	42002-7	No data	NA	NA	Control.	0	24	Yes.	Irreversible eye damage. Harmful if swallowed, absorbed through skin, or inhaled. May cause dermal sensitization. [F]	Toxic to fish and aquatic organisms.	Damages aluminum.
Synthetic	M1	Copper hydroxide	Champ WG	55146-1	7	1	2:SMF022	Control.	0	48	Yes.	Irreversible eye damage. Harmful if swallowed. May cause dermal sensitization. [F]	Toxic to fish and aquatic organisms.	Damages aluminum.
Synthetic	M1	Copper hydroxide, Copper oxychloride	Badge X2	80289-12	No data	NA	NA	Control.	0	48	Yes.	May be fatal if swallowed. Substantial eye injury.	Toxic to fish and aquatic organisms.	May damage aluminum.
Synthetic	M1	Copper sulfate pentahydrate	CS 2005	66675-3	No data	NA	NA	Control.	0	48	Yes.	Irreversible eye damage. Skin irritation. Harmful if swallowed, inhaled or absorbed through skin.	Toxic to fish and aquatic organisms.	Incompatible with galvanized pipe and nylon equipment.
Synthetic	M1	Cupric hydroxide	Nu-Cup HB	42750-132	No data	NA	NA	Control.	1	24	Yes.	Irreversible eye damage. Harmful if swallowed or absorbed through skin.	Toxic to fish and aquatic organisms.	Damages aluminum.
Synthetic	M1	Cuprous oxide	Nordox 75 WG	48142-4	No data	NA	NA	Control.	0	12	Yes.	Harmful if swallowed or absorbed through skin. Eye irritation.	None.	Water pH restrictions.

A. FRAC = Fungicide Resistance Action Committee. Products with the same mode of action have the same FRAC Code. NC = Not classified; no FRAC code has been assigned.
B. For Polyoxin D zinc salt (Oso), from summarizes trials, published and unpublished. For OMRI-listed alternatives, from Plant Disease Management Reports (PDMR).
C. Number of trials included in the calculation of the mean.
D. PDMR = Plant Disease Management Reports (on-line journal generally used for publication of efficacy research conducted at universities). Preceded by F&N = Fungicides and Nematicides. https://www.plantmanagementnetwork.org/pub/trial/pdmr/
E. Mix-and-match directions for use. Label has a list of crops and a separate list of diseases with no claim for specific crop/disease combinations.
F. Complete label statement: Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals.
G. EPA relative environmental toxicity descriptors, lowest toxicity to highest toxicity: Practically non-toxic < Moderately toxic < Toxic < Highly toxic.

Plant Disease Management Reports citations and data summaries:

2:SMF002. P. McManus and R. S. Perry, University of Wisconsin. Evaluation of fungicides for control of cranberry fruit rot in Wisconsin, 2007.
Champ at 5.33 pt/A, applied June 19 and 26, 2007: 10% and 12% control.
Champ at 5.33 pt/A, applied June 6 and July 9, 2007: No control. Disease control was less than in the untreated control.
Trial mean: 7.3% control (n = 3).

OMRI-LISTED ALTERNATIVES: CROP GROUP 13: BERRIES: GRAPES / Black Rot (*Guignardia bidwellii*)

Comparative Overview of Efficacy, Hazards, and Use Restrictions
Crop Group 13: Berries and Small Fruits: Grapes / Black Rot (*Guignardia bidwellii*)

NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Synthetic	19	Polyoxin D zinc salt	Oso	68173-4	54	4	See Oso efficacy summary table.	Suppression.	0	4	None.	May cause dermal sensitization. [F]	Moderately toxic to fish and aquatic invertebrates.	None.
Non-synthetic	44	*Bacillus amylo-liquefaciens* strain F727	Stargus	84059-28	No data	NA	NA	Control. Preventative only.	0	4	None.	Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Not for sale or use after 18 months from the date of manufacture. Avoid freezing.
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade Max	264-1151	No data	NA	NA	Control. Preventative only.	0	4	None.	May cause dermal sensitization. [F]	None.	None.
Non-Synthetic	P5	*Reynoutria sachalinensis* extract	Regalia	84059-3	8	3	8:SMF014; 7:SMF003; 6:SMF008.	Control. Preventative only.	0	4	None.	Moderate eye irritation.	None.	Avoid freezing.
Non-synthetic	NC; Botanical oil	Rosemary oil, Clove oil, Thyme oil	Sporatec	NA; 25(b)	No data	NA	NA	Control.	0	0	Yes.	Harmful if swallowed.	Toxic to bees.	Not for use near heat or open flames.
Synthetic	M1	Basic copper sulfate	Basic Copper 53	45002-8	No data	NA	NA	Suppression.	0	24	Yes.	Substantial eye injury.	Toxic to fish and aquatic organisms.	Damages aluminum.
Synthetic	M1	Copper oxychloride, Copper hydroxide	Badge X2	50289-12	54	2	8:SMF014; 6:SMF008.	Control.	0	48	Yes.	May be fatal if swallowed. Substantial eye injury.	Toxic to fish and aquatic organisms.	May damage aluminum.
Synthetic	M1	Copper hydroxide	Champ WG	55146-1	No data	NA	NA	Control.	0	48	Yes.	Irreversible eye damage. Harmful if swallowed. May cause dermal sensitization. [F]	Toxic to fish and aquatic organisms.	Damages aluminum.
Synthetic	M1	Copper hydroxide	Nu-Cop 50 WP	42002-7	78	2	6:SMF008.	Control.	0	24	Yes.	Irreversible eye damage. Harmful if swallowed, absorbed through skin, or inhaled. May cause dermal sensitization. [F]	Toxic to fish and aquatic organisms.	Damages aluminum.
Synthetic	M1	Copper octanoate	Cueva	67702-2-70051	32	3	3:SMF030; 3:SMF031; 2:SMF004.	Control.	0	4	Yes.	Harmful if swallowed or absorbed through skin.	Toxic to fish and aquatic organisms.	Do not store below 4°C (39°F). Tank-mix restrictions.
Synthetic	M1	Copper sulfate pentahydrate	CS 2005	66675-3	No data	NA	NA	Control.	0	48	Yes.	Irreversible eye damage. Skin irritation. Harmful if swallowed, inhaled or absorbed through skin.	Toxic to fish and aquatic organisms.	Incompatible with galvanized pipe and nylon equipment.

Comparative Overview of Efficacy, Hazards, and Use Restrictions
Crop Group 13: Berries and Small Fruits: Grapes / Black Rot (*Guignardia bidwellii*)

NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Synthetic	M1	Cupric hydroxide	NuCop 50 DF	45002-4	No data	NA	NA	Control.	1	24	Yes.	Irreversible eye damage. Harmful if swallowed or absorbed through skin. May cause dermal sensitization. [F]	Toxic to fish and aquatic organisms.	Damages aluminum.
Synthetic	M1	Cupric hydroxide	Nu-Cop HB	42750-132	No data	NA	NA	Control.	1	24	Yes.	Irreversible eye damage. Harmful if swallowed or absorbed through skin.	Toxic to fish and aquatic organisms.	Damages aluminum.
Synthetic	M1	Cuprous oxide	Nordox 75 WG	48142-4	No data	NA	NA	Control.	0	12	Yes.	Harmful if swallowed or absorbed through skin. Eye irritation.	None.	Water pH restrictions.
Synthetic	NC; oxidizing agent	Hydrogen dioxide, Peroxyacetic acid	Oxidate 2.0	70299-2	0	1	F&N 56:SMF19.	Control.	0	Until dry	None.	Irreversible eye damage. May be fatal if swallowed. Skin irritation.	Highly toxic to bees and other beneficial insects. Toxic to fish.	Chemical instabilities. Strong oxidizing agent. Use and storage temperature restrictions.

A. FRAC = Fungicide Resistance Action Committee. Products with the same mode of action have the same FRAC Code. NC = Not classified; no FRAC code has been assigned.
B. For Polyoxin D zinc salt (Oso), from summarizes trials, published and unpublished. For OMRI-listed alternatives, from Plant Disease Management Reports (PDMR).
C. Number of trials included in the calculation of the mean.
D. PDMR = Plant Disease Management Reports (on-line journal generally used for publication of efficacy research conducted at universities). Preceded by F&N = Fungicides and Nematicides. https://www.plantmanagementnetwork.org/pub/trial/pdmr/
E. Mix-and-match directions for use. Label has a list of crops and a separate list of diseases with no claim for specific crop/disease combinations.
F. Complete label statement: Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals.
G. EPA relative environmental toxicity descriptors, lowest toxicity to highest toxicity: Practically non-toxic < Moderately toxic < Toxic < Highly toxic.

Plant Disease Management Reports citations and data summaries for non-synthetic alternatives:

8:SMF014. Grape/black rot. Bryan Hed. Penn State University. Evaluation of organic fungicides for control of black rot and powdery and downy mildew of Concord grapes, 2013.
Regalia 5% at 6 quarts/A; *without* mummies: 46% control on fruit.
Regalia 5% at 6 quarts/A; *with* mummies: 0% control on fruit.
Trial mean: 23% control (n = 2).

7:SMFF003. Grape/black rot. Bryan Hed. Penn State University. Evaluation of organic fungicides for control of black rot and powdery mildew of Concord grapes, 2012.
Regalia 5% at 6 quarts/A, *without* mummies: Insufficient pest pressure.
Regalia 5% at 6 quarts/A, *with* mummies: No control. More disease than in the untreated control on fruit.

6:SMF008. Grape/black rot. Bryan Hed. Penn State University. Evaluation of conventional and organic fungicides for control of black rot and powdery mildew of Concord grapes, 2011.
Regalia 5% at 6 quarts/A + NuFilm P at 0.0625%; *without* mummies: Insufficient pest pressure.
Regalia 5% at 6 quarts/A + NuFilm P at 0.0625%; *with* mummies: 1.8% control of diseased clusters. No control of diseased area on clusters.
Trial mean: 1% control (n = 2).

Comparative Overview of Efficacy, Hazards, and Use Restrictions
Crop Group 13: Berries and Small Fruits: Grapes / Black Rot (*Guignardia bidwellii*)

NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical

Plant Disease Management Reports citations and data summaries for synthetic alternatives:

8:SMF014. Bryan Hed, Penn State University. Evaluation of organic fungicides for control of black rot and powdery and downy mildew of Concord grapes, 2013.
Badge X2 1.75 lb/A + lime 1.75 lb/A, 5 or more applications, different timings; *without* mummies: 64%, 77%, 81%, and 90% control on fruit.
Badge X2 1.75 lb/A + lime 1.75 lb/A, 5 or more applications, different timings; *with* mummies: 4%, 5%, 15%, and 22% control on fruit.
Badge X2 1.75 lb/A + lime 1.75 lb/A + Nu-Film-P, 5 or more applications, different timings; *without* mummies: 66.5%, and 71% control on fruit.
Badge X2 1.75 lb/A + lime 1.75 lb/A + Nu-Film-P, 5 or more applications, different timings; *with* mummies: 9% and 9% control on fruit.
Trial mean: 43% control (n = 12).

6:SMF008. B. Hed and N. K. Ngugi, Penn State University. Evaluation of conventional and organic fungicides for control of black rot and powdery mildew of Concord grapes, 2011.
NuCop 50 WP at 1 lb/A + Lime at 1 lb/A + Nufilm P at 0.0625%: 67% control of diseased clusters; 85% control of diseased area.
NuCop 50 WP at 2 lb/A + Lime at 2 lb/A + Nufilm P at 0.0625%: 65% control of diseased clusters; 91% control of diseased area.
NuCop 50 WP trial mean: 77% control (n = 4).
Badge X2 at 1.75 lb/A + Lime at 1.75 lb/A + Nufilm P at 0.0625%: 52% control of diseased clusters; 75% control of diseased area.
Badge X2 trial mean: 64% control (n = 2).

3:SMF030. Bryan Hed, Penn State University. Evaluation of organic fungicides for control of black rot and powdery mildew, 2008.
Cueva 1%; 6 applications beginning intermediate pre-bloom: 39% control on fruit.

3:SMF031. Bryan Hed, Penn State University. Evaluation of alternative fungicides of black rot, powdery mildew, and downy mildew of grapes, 2008.
Cueva 1%; 7 applications beginning at immediate pre-bloom.
Cane inoculum plus mummies: 23% control on fruit.
Wood inoculum only: 0% control on fruit.
Trial mean: 12% control (n = 2).

2:STF004. Bryan Hed, Penn State University. Evaluation of organic fungicides for control of black rot and powdery mildew of Concord grapes, 2007.
Cueva at 1 gal/A; 4 applications beginning June 6, 2017: 45% control on fruit.
Cueva at 2 gal/A; 4 applications beginning June 6, 2017: 44% control on fruit.
Trial mean: 45% control (n =2).

F&N Test 56:SMF19. M. Ellis *et al.* Ohio State University. Evaluations of fungicides for control of Grape Black Rot, 2000.
Oxidate 27% L at 128 fl oz/A; 7 applications: No control of leaf infections. No control of fruit infections. More disease than in the untreated control.

OMRI-LISTED ALTERNATIVES: CROP GROUP 13: BERRIES: GRAPES / Bunch Rot (*Botrytis cinerea*)

Comparative Overview of Efficacy, Hazards, and Use Restrictions Crop Group 13: Berries and Small Fruits: Grapes / Bunch Rot (*Botrytis cinerea*)														
NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Synthetic	19	Polyoxin D zinc salt	Oso	68173-4	66	6	See Oso efficacy summary table.	Control.	0	4	None.	May cause dermal sensitization. [F]	Moderately toxic to fish and aquatic invertebrates.	None.
Non-synthetic	44	*Bacillus amylo-liquefaciens* strain D747	Double Nickel 55	70051-108	74	1	9:SMF001.	Control. Preventative only.	0	4	None.	Moderate eye irritation. May cause dermal sensitization. [F]	None.	Water pH restrictions.
Non-synthetic	44	*Bacillus amylo-liquefaciens* strain D747	Double Nickel LC	70051-114	95	1	9:SMF001.	Control. Preventative only.	0	4	None.	Moderate eye irritation. May cause dermal sensitization. [F]	None.	Water pH restrictions.
Non-synthetic	44	*Bacillus amylo-liquefaciens* strain F727	Stargus	84059-28	No data	NA	NA	Control. Preventative only.	0	4	None.	Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Not for sale or use after 18 months from the date of manufacture. Avoid freezing.
Non-synthetic	44	*Bacillus amylo-liquefaciens* strain MBI 600	Serifel	71840-18	No data	NA	NA	Control. Preventative only. Not for use in California.	0	4	None.	Moderate eye irritation. Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	None.
Non-synthetic	44	*Bacillus pumilus* strain QST 2808	Sonata	264-1153	No data	NA	NA	Control. Preventative only.	0	4	None.	Harmful if inhaled. May cause dermal sensitization. [F] Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Spray solution pH restrictions.
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Optiva	264-1160	No data	NA	NA	Control. Preventative only.	0	4	None.	Moderate eye irritation. May cause dermal sensitization. [F]	None.	None.
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade ASO	264-1152	22	4	5:SMF010; F&N 61:SMF034; F&N 58:SMF026.	Control. Preventative only.	0	4	None.	Harmful if inhaled.	None.	None.

Comparative Overview of Efficacy, Hazards, and Use Restrictions Crop Group 13: Berries and Small Fruits: Grapes / Bunch Rot (*Botrytis cinerea*)													
NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade Max	264-1151	39	4	6:SMF047; 5:SMF049; 5:SMF057; 2:SMF009.	Control. Preventative only.	0	4	None.	May cause dermal sensitization. [F]	None.	None.
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade Optimum	264-1160	32	1	9:SMF023.	Control. Preventative only.	0	4	None.	Moderate eye irritation. May cause dermal sensitization. [F]	None.	None.
Non-synthetic	P5	*Reynoutria sachalinensis* extract	Regalia	84059-3	38	1	9:SMF023.	Control. Preventative only.	0	4	None.	Moderate eye irritation.	None.	Avoid freezing.
Non-synthetic	NC; Biological	*Aureobasidium pullulans* strains DSM 14940 and DSM 14941	Botector	86174-3	23	4	10:SMF030; 9:SMF013; 9:SMS023; 8:SMF015.	Control. Preventative only.	0	4	None.	Harmful if swallowed or absorbed through skin. Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Live yeast-like fungus. Use and storage temperature restrictions. Not compatible with many fungicides.
Non-synthetic	NC; Biological	*Streptomyces lydicus*	Actinovate AG	73314-1	No data	NA	NA	Botrytis claim. Mix-and-match directions for use. [E] No specific crop/disease claims. Field uses: Control vs suppression only is not specified. Greenhouse uses: Suppression only.	0	1 or until dry	None.	Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Live bacterium. Use and storage temperature restrictions.
Non-synthetic	NC; Biological	*Ulacladium ouderansii* strain U3	Zen-O-Spore	75747-2	No data	NA	NA	Control.	0	4	None.	Harmful if inhaled. Moderate eye irritation. Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Live fungal spores. Store below 68°F.
Non-synthetic	NC; Botanical oil	Neem oil	Trilogy	70051-2	No data	NA	NA	Botrytis control claim. Mix-and-match directions for use. [E] No specific crop/disease claims.	0	4	Yes.	Moderate eye irritation.	Toxic to fish, aquatic organisms, and bees.	Temperature restrictions. Storage restrictions.

Comparative Overview of Efficacy, Hazards, and Use Restrictions Crop Group 13: Berries and Small Fruits: Grapes / Bunch Rot (*Botrytis cinerea*)														
NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Non-synthetic	NC; Botanical oil	Clove oil, Rosemary oil, Peppermint oil	BacStop	NA; 25(b)	No data	NA	NA	Control.	0	0	None.	Temporary eye and skin irritation	No FIFRA statements.	Storage temperature restrictions.
Non-synthetic	NC; Botanical oil	Rosemary oil, Clove oil, Thyme oil	Sporatec	NA; 25(b)	No data	NA	NA	Control.	0	0	Yes.	Harmful if swallowed.	Toxic to bees.	Not for use near heat or open flames.
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Agricure	70870-1	No data	NA	NA	Botrytis control claim. Mix-and-match directions for use. [E] No specific crop/disease claims.	0	1	None.	Harmful if swallowed. Moderate eye irritation.	None.	Mild alkaline solution; tank-mix restrictions.
Synthetic	NC; Inorganic salt	Potassium bicarbonate	EcoMate Armicarb O	5905-541	20	1	F&N 55:SMF116	Control.	0	4	None.	Harmful is swallowed. Moderate eye irritation.	None.	Avoid contamination by pesticides and fertilizers. Final spray solution pH must be ≥7.0.
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Milstop	70870-1-68539	No data	NA	NA	Botrytis control claim. Mix-and-match directions for use. [E] No specific crop/disease claims.	0	1	None.	Harmful is swallowed. Moderate eye irritation.	None.	Mild alkaline solution; tank-mix restrictions.
Synthetic	NC; Oxidizing agent	Hydrogen dioxide, Peroxyacetic acid	Oxidate 2.0	70299-2	26	2	5:SMF049; 5:SMF057.	Control.	0	Until dry	None.	Irreversible eye damage. May be fatal if swallowed. Skin irritation.	Highly toxic to bees and other beneficial insects. Toxic to fish.	Chemical instabilities. Strong oxidizing agent. Use and storage temperature restrictions.
Synthetic	NC; Oxidizing agent	Hydrogen peroxide, Hydrogen dioxide	Perpose Plus	86729-1	No data	NA	NA	Botrytis control claim for all agricultural crops. Preventative only.	0	Until dry	None.	Irreversible eye damage and skin burns. May be fatal if absorbed through skin. Harmful if swallowed.	Toxic to birds, mammals, fish, and aquatic life.	Chemical instabilities. Strong oxidizing agent. Storage restrictions.
Synthetic	NC; Petroleum oil	Mineral oil	JMS Stylet Oil	65564-1	10	2	2:SMF036; F&N 61:SMF038	Control.	0	4	Yes. (with sulfur).	Harmful if swallowed.	Toxic to fish.	None.
Synthetic	NC; Petroleum oil	Mineral oil	PureSpray Green	69526-9	No data	NA	NA	Control.	0	4	Yes (with sulfur).	Harmful if swallowed or absorbed through skin. May cause dermal sensitization. [F]	Toxic to aquatic organisms.	None.
Synthetic	NC; Petroleum oil	Aliphatic petroleum solvent	SuffOil-X	48813-1-68539	No data	NA	NA	Control.	0	4	Yes (with sulfur).	Harmful if swallowed. May cause dermal sensitization. [F]	Toxic to aquatic organisms.	None.

Comparative Overview of Efficacy, Hazards, and Use Restrictions
Crop Group 13: Berries and Small Fruits: Grapes / Bunch Rot (*Botrytis cinerea*)

NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Synthetic	NC; Petroleum oil	Mineral oil	TriTek	48813-1	No data	NA	NA	Control.	0	4	Yes (with sulfur).	Harmful if swallowed or absorbed through skin. May cause dermal sensitization. [F]	Toxic to aquatic organisms.	None.

A. FRAC = Fungicide Resistance Action Committee. Products with the same mode of action have the same FRAC Code. NC = Not classified; no FRAC code has been assigned.
B. For Polyoxin D zinc salt (Oso), from summarizes trials, published and unpublished. For OMRI-listed alternatives, from Plant Disease Management Reports (PDMR).
C. Number of trials included in the calculation of the mean.
D. PDMR = Plant Disease Management Reports (on-line journal generally used for publication of efficacy research conducted at universities). Preceded by F&N = Fungicides and Nematicides. https://www.plantmanagementnetwork.org/pub/trial/pdmr/
E. Mix-and-match directions for use. Label has a list of crops and a separate list of diseases with no claim for specific crop/disease combinations.
F. Complete label statement: Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals.
G. EPA relative environmental toxicity descriptors, lowest toxicity to highest toxicity: Practically non-toxic < Moderately toxic < Toxic < Highly toxic.

Comparative Overview of Efficacy, Hazards, and Use Restrictions
Crop Group 13: Berries and Small Fruits: Grapes / Bunch Rot (*Botrytis cinerea*)

NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical

Plant Disease Management Reports citations and data summaries for non-synthetic alternatives:

10:SMF030. J.W. Pscheidt and J. P. Bassinette, Oregon State University. Efficacy of Fungicides for Management of Grape Bunch Rot, 2015.
Botector at 10 oz/A: 80.1%, 61.8%, 43.2%, and 82.1% control of incidence (9/13/2015, 9/22/2015, 9/28/2015) and Severity (9/28/2015), respectively. Trial mean: 66.8% control (n = 4).

9:SMF001. T. T. Nguyen, N.S. Morris, and W. D. Gubler, University of California, Davis. Management of Grape Botrytis Bunch Rot with experimental, organic and conventional fungicides, 2014.
Double Nickel LC at 2 qt/A: 93% and 96% control of Botrytis bunch rot (severity and incidence, respectively). Trial mean: 95% control (n = 2).
Double Nickel 55WDG at 20 oz/A: 70% and 78% control of Botrytis bunch rot (severity and incidence, respectively). Trial mean: 74% control (n = 2).

9:SMF013. B. Hed, Pennsylvania State University. Evaluation of Leaf Removal, Botector, Foliar Nutrients, and Fungicides for Control of Botrytis Bunch Rot of Grapes, 2014.
Botector at 5 oz/A: 1.7% control of Botrytis incidence on clusters. 11.2% control of Botrytis severity on clusters. Trial mean: 6.5% control (n = 2).

9:SMF023. L. J. Bettiga, University of California Cooperative Extension (Salinas). Evaluation of fungicides for the control of Botrytis bunch rot of grape, 2014.
Regalia at 2 qt/A + Kinetic at 0.05%: 29% control of Botrytis bunch rot incidence. 47% control of Botrytis bunch rot severity. Trial mean: 38% control (n = 2).
Serenade Optimum at 1 lb/A + Kinetic at 0.05%: 26% control of Botrytis bunch rot incidence. 38% control of Botrytis bunch rot severity. Trial mean: 32% control (n = 2).
Botector at 7 oz/A + Kinetic at 0.05%: 30% control of Botrytis bunch rot incidence. 53% control of Botrytis bunch rot severity. Trial mean: 42% control (n = 2).

8:SMF015. B. Hed, Pennsylvania State University. Evaluation of Leaf Removal, ProGibb, Vapor Gard, and Fungicides for the Control of Botrytis Bunch Rot of Grapes, 2013.
Botector at 5 oz/A: 16.7% control of Botrytis bunch rot incidence. 37.5% control of Botrytis bunch rot severity. Trial mean: 27.1% control (n = 2).

6:SMF047. W. F. Wilcox and D. G. Riegel, Cornell University. Evaluation of fungicide programs for control of Botrytis bunch rot of grapes, 2010.
Serenade Max at 1.5 lb/A: 36% control of Botrytis on clusters. 34% control of diseased area on clusters. Trial mean: 35% control (n = 2).

5:SMF010. I.S. Bay, J. D. Eynard, and W. D. Gubler, University of California, Davis. Fungicide programs for control of Botrytis bunch rot of grape, 2010.
Serenade (formulation not specified; assume ASO = liquid) at 4 qt/A: 39% and 30% control of Botrytis bunch rot incidence and severity, respectively. Trial mean: 35% control (n = 2).

5:SMF049. A. M.C. Schilder, J. M. Gillett, and R. W. Sysak, Michigan State University. Evaluation of fungicide programs for control of bunch rots and downy mildew in 'Vignoles' grapes, 2008.
Serenade Max at 3 lb/A + NuFilm-17 at 0.5 pt/A: 37% control of Botrytis bunch rot.

5:SMF057. A. M.C. Schilder, J. M. Gillett, and R. W. Sysak, Michigan State University. Evaluation of fungicide programs for control of bunch rots in 'Vignoles' grapes, 2009.
Serenade Max at 3 lb/A + Nu-Film P at 0.5 pt/A: 55% control of Botrytis bunch rot.

2:SMF009. W. F. Wilcox and D. G. Riegel, Cornell University. Evaluation of fungicide programs for control of Botrytis bunch rot of grapes, 2007.
Serenade Max 2.0 lb + Biotune (adjuvant) at 0.13%: 13% control of Botrytis bunch rot on clusters. 45% control of infected cluster area. Trial mean: 29% control (n = 2).

F&N 61:SMF034. W. F. Wilcox and D. G. Riegel, Cornell University. Evaluation of fungicide programs for control of Botrytis bunch rot of grapes, 2005.
Serenade (unspecified formulation; assume ASO = liquid) at 4.0 qt/A + Biotune (adjuvant) at 0.125% (v/v): 36% control of Botrytis on clusters. 33% control of diseased area on clusters.
Trial mean: 35% control (n = 2).

F&N 58:SMF026. A. Baudoin, Virginia Polytechnic Institute and State University. Evaluation of fungicides for control of grape bunch and other late-season rots, 2002.
Serenade (formulation not specified) at 6 lb/A, Stanardsville trial: No control of Botrytis incidence and severity. More disease than in the untreated control.
Serenade (formulation not specified) at 6 lb/A, Linden trial: 18% control of Botrytis incidence. 20% control of Botrytis severity. Trial mean: 19% control (n =2).

Comparative Overview of Efficacy, Hazards, and Use Restrictions Crop Group 13: Berries and Small Fruits: Grapes / Bunch Rot (*Botrytis cinerea*)													
NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Plant Disease Management Reports citations and data summaries for synthetic alternatives: 5:SMF049. A. M.C. Schilder, J. M. Gillett, and R. W. Sysak, Michigan State University. Evaluation of fungicide programs for control of bunch rots and downy mildew in 'Vignoles' grapes, 2008. Oxidate at 1% (v/v)/A: 43% control of Botrytis bunch rot. 5:SMF057. A. M.C. Schilder, J. M. Gillett, and R. W. Sysak, Michigan State University. Evaluation of fungicide programs for control of bunch rots in 'Vignoles' grapes, 2009. Oxidate at 1% (v/v)/A: 8.0% control of Botrytis bunch rot. 2:SMF036. J. Hashim-Buckey, University of California (Bakersfield). Evaluation of vineyard fungicide applications to control postharvest rot of table grapes, 2006. JMS Stylet-Oil at 1 gal/A: 0% control of post-harvest Botrytis bunch rot. Untreated control has less disease. F&N 61:SMF038. B. Hed and J.W. Travis, Penn State Research and Extension Centers. Evaluation of cultural methods and oils for improving control of Botrytis bunch rot of grapes, 2005. JMS Stylet-Oil at 2% (v/v), 2 treatments with 2 applications each, different timing: 0% and 39% control of Botrytis bunch rot. Trial mean: 20% control (n = 2). F&N 55:116. W. F. Wilcox and D. G. Riegel. Evaluation of fungicide programs for control of Botrytis bunch rot of grapes, 1999. Armicarb 100 at 2.5 lb/A: 20% control of Botrytis bunch rot on clusters. Armicarb 100 at 4.8 lb/A: 20% control of Botrytis bunch rot on clusters. Trial mean: 20% control (n = 2). References with especially low disease pressure in the untreated control are not summarized (F&N 58:SMF035).													

OMRI-LISTED ALTERNATIVES: CROP GROUP 13: BERRIES: GRAPES / Downy Mildew (*Plasmopara viticola*)

Comparative Overview of Efficacy, Hazards, and Use Restrictions Crop Group 13: Berries and Small Fruits: Grapes / Downy Mildew (*Plasmopara viticola*)														
NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Synthetic	19	Polyoxin D zinc salt	Oso	68173-4	95	2	See Oso efficacy summary table.	Control.	0	4	None.	May cause dermal sensitization. [F]	Moderately toxic to fish and aquatic invertebrates.	None.
Non-synthetic	44	*Bacillus amylo-liquefaciens* strain D747	Double Nickel 55	70051-108	No data	NA	NA	Suppression only. Preventative only.	0	4	None.	Moderate eye irritation. May cause dermal sensitization.	None.	Water pH restrictions.
Non-synthetic	44	*Bacillus amylo-liquefaciens* strain D747	Double Nickel LC	70051-114	No data	NA	NA	Suppression only. Preventative only.	0	4	None.	Moderate eye irritation. May cause dermal sensitization. [F]	None.	Water pH restrictions.
Non-synthetic	44	*Bacillus amylo-liquefaciens* strain F727	Stargus	84059-28	No data	NA	NA	Control. Preventative only.	0	4	None.	Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Not for sale or use after 18 months from the date of manufacture. Avoid freezing.
Non-synthetic	44	*Bacillus amylo-liquefaciens* strain MBI 600	Serifel	71840-18	No data	NA	NA	Control. Preventative only. Not for use in California.	0	4	None.	Moderate eye irritation. Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	None.
Non-synthetic	44	*Bacillus mycoides*, isolate J	LifeGard WG	70051-119	No data	NA	NA	No direct effect on plant pathogen; plant protectant; preventative.	0	4	None.	Harmful if inhaled. Moderate eye irritation. Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Store at temperatures below 77°F.
Non-synthetic	44	*Bacillus pumilus* strain QST 2808	Sonata	264-1153	No data	NA	NA	Control. Preventative only.	0	4	None.	Harmful if inhaled. May cause dermal sensitization. [F] Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None	Spray solution pH restrictions.

Comparative Overview of Efficacy, Hazards, and Use Restrictions
Crop Group 13: Berries and Small Fruits: Grapes / Downy Mildew (*Plasmopara viticola*)

NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade ASO	264-1152	No data	NA	NA	Suppression only. Preventative only.	0	4	None.	Harmful if inhaled.	None.	None.
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade Max	264-1151	42	1	3:SMF031	Suppression only. Preventative only.	0	4	None.	May cause dermal sensitization. [F]	None.	None.
Non-synthetic	P5	*Reynoutria sachalinensis* extract	Regalia	84059-3	37	1	8:SMF014.	Control. Preventative only.	0	4	None.	Moderate eye irritation.	None.	Avoid freezing.
Non-synthetic	NC; Biological	*Streptomyces lydicus*	Actinovate AG	73314-1	No data	NA	NA	Downy mildew claim. Mix-and-match directions for use. [E] No specific crop/disease claims. Field uses: Control vs suppression only is not specified. Greenhouse uses: Suppression only.	0	1 or until dry	None.	Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Live bacterium. Use and storage temperature restrictions.
Non-synthetic	NC; Botanical oil	Neem oil	Trilogy	70051-2	No data	NA	NA	Downy mildew control claim. Mix-and-match directions for use. [E] No specific crop/disease claims.	0	4	Yes.	Moderate eye irritation.	Toxic to fish, aquatic organisms, and bees.	Temperature restrictions. Storage restrictions.
Non-synthetic	NC; Botanical oil	Rosemary oil, Clove oil, Thyme oil	Sporatec	NA; 25(b)	No data	NA	NA	Control.	0	0	Yes.	Harmful if swallowed.	Toxic to bees.	Not for use near heat or open flames.
Synthetic	M1	Basic copper sulfate	Basic Copper 53	45002-8	No data	NA	NA	Control.	0	24	Yes.	Substantial eye injury.	Toxic to fish and aquatic organisms.	Damages aluminum.
Synthetic	M1	Copper oxychloride, Copper hydroxide	Badge X2	80289-12	99 (with lime)	1	8:SMF014	Control.	0	48	Yes.	May be fatal if swallowed. Substantial eye injury.	Toxic to fish and aquatic organisms.	May damage aluminum.
Synthetic	M1	Copper hydroxide	Champ WG	55146-1	No data	NA	NA	Control.	0	48	Yes.	Irreversible eye damage. Harmful if swallowed. May cause dermal sensitization. [F]	Toxic to fish and aquatic organisms.	Damages aluminum.

Comparative Overview of Efficacy, Hazards, and Use Restrictions Crop Group 13: Berries and Small Fruits: Grapes / Downy Mildew (*Plasmopara viticola*)														
NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Synthetic	M1	Copper hydroxide	Nu-Cop 50 WP	42002-7	No data	NA	NA	Control.	0	24	Yes.	Irreversible eye damage. Harmful if swallowed, absorbed through skin, or inhaled. May cause dermal sensitization. [F]	Toxic to fish and aquatic organisms.	Damages aluminum.
Synthetic	M1	Copper octanoate	Cueva	67702-2-70051	93	1	3:SMF031	Control.	0	4	Yes.	Harmful if swallowed or absorbed through skin.	Toxic to fish and aquatic organisms.	Do not store below 4°C (39°F). Tank-mix restrictions.
Synthetic	M1	Copper sulfate pentahydrate	CS 2005	66675-3	No data	NA	NA	Control.	0	48	Yes.	Irreversible eye damage. Skin irritation. Harmful if swallowed, inhaled or absorbed through skin.	Toxic to fish and aquatic organisms.	Incompatible with galvanized pipe and nylon equipment.
Synthetic	M1	Copper sulfate pentahydrate	Copper Sulfate Crystals	56576-1	No data	NA	NA	Control.	0	24	Yes.	Corrosive. Causes eye damage. Skin irritation.	Toxic to fish.	None.
Synthetic	M1	Copper sulfate pentahydrate	Quimag Quimicos Arguila Copper Sulfate Crystals	73385-3	No data	NA	NA	Control.	0	24	Yes.	Irreversible eye damage. Maybe fatal if swallowed. RESTRICTED USE PESTICIDE.	Toxic to fish and aquatic invertebrates. ENDANGERED SPECIES RESTRICTIONS.	Possible incompatibility with aluminum, rubber, etc.
Synthetic	M1	Cupric hydroxide	NuCop 50 DF	45002-4	No data	NA	NA	Control.	1	24	Yes.	Irreversible eye damage. Harmful if swallowed or absorbed through skin. May cause dermal sensitization. [F]	Toxic to fish and aquatic organisms.	Damages aluminum.
Synthetic	M1	Cupric hydroxide	Nu-Cop HB	42750-132	No data	NA	NA	Control.	1	24	Yes.	Irreversible eye damage. Harmful if swallowed or absorbed through skin.	Toxic to fish and aquatic organisms.	Damages aluminum.
Synthetic	M1	Cuprous oxide	Nordox 75 WG	48142-4	No data	NA	NA	Control.	0	12	Yes.	Harmful if swallowed or absorbed through skin. Eye irritation.	None.	Water pH restrictions.
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Agricure	70870-1	No data	NA	NA	Downy mildew control claim. Mix-and-match directions for use. [E] No specific crop/disease claims. Not for use in California.	0	1	None.	Harmful if swallowed. Moderate eye irritation.	None.	Mild alkaline solution; tank- mix restrictions.

Comparative Overview of Efficacy, Hazards, and Use Restrictions
Crop Group 13: Berries and Small Fruits: Grapes / Downy Mildew (*Plasmopara viticola*)

NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Synthetic	NC; Inorganic salt	Potassium bicarbonate	EcoMate Armicarb O	5905-541	No data	NA	NA	Control.	0	4	None.	Harmful is swallowed. Moderate eye irritation.	None.	Avoid contamination by pesticides and fertilizers. Final spray solution pH must be ≥7.0.
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Milstop	70870-1-68539	No data	NA	NA	Downy mildew control claim. Mix-and-match directions for use. [E] No specific crop/disease claims. Not for use in California.	0	1	None.	Harmful is swallowed. Moderate eye irritation.	None.	Mild alkaline solution; tank-mix restrictions.
Synthetic	NC; Oxidizing agent	Hydrogen dioxide, Peroxyacetic acid	Oxidate 2.0	70299-2	92 (leaves)	1	5:SMF049.	Control.	0	Until dry	None.	Irreversible eye damage. May be fatal if swallowed. Skin irritation.	Highly toxic to bees and other beneficial insects. Toxic to fish.	Chemical instabilities. Strong oxidizing agent. Use and storage temperature restrictions.
Synthetic	NC; Oxidizing agent	Hydrogen peroxide, Hydrogen dioxide	Perpose Plus	86729-1	No data	NA	NA	Downy mildew control claim for all agricultural crops. Preventative only.	0	Until dry	None.	Irreversible eye damage and skin burns. May be fatal if absorbed through skin. Harmful if swallowed.	Toxic to birds, mammals, fish, and aquatic life.	Chemical instabilities. Strong oxidizing agent. Storage restrictions.

A. FRAC = Fungicide Resistance Action Committee. Products with the same mode of action have the same FRAC Code. NC = Not classified; no FRAC code has been assigned.
B. For Polyoxin D zinc salt (Oso), from summarizes trials, published and unpublished. For OMRI-listed alternatives, from Plant Disease Management Reports (PDMR).
C. Number of trials included in the calculation of the mean.
D. PDMR = Plant Disease Management Reports (on-line journal generally used for publication of efficacy research conducted at universities). Preceded by F&N = Fungicides and Nematicides. https://www.plantmanagementnetwork.org/pub/trial/pdmr/
E. Mix-and-match directions for use. Label has a list of crops and a separate list of diseases with no claim for specific crop/disease combinations.
F. Complete label statement: Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals.
G. EPA relative environmental toxicity descriptors, lowest toxicity to highest toxicity: Practically non-toxic < Moderately toxic < Toxic < Highly toxic.

8:SMF014. B. Hed, Penn State University. Evaluation of organic fungicides for control of black rot and powdery and downy mildew of Concord grapes, 2013.
Regalia 5% at 6 quarts/A; 6 applications beginning May 20, 2013: 37% control on fruit.
Badge X2 at 1.75 lb/A + lime at 1.75 lb/A, different application timings: 96%, 99%, 100%, and 100% control of downy mildew on grapes (fruit).
Badge X2 at 1.75 lb/A + lime at 1.75 lb/A + Nu-Film-P at 0.0625%, different application timings: 100% and 100% control of downy mildew on grapes (fruit).
Badge X2 trial mean: 99% control (n = 6).

5:SMF049. A. Schilder, *et al.* Michigan State University. Evaluation of fungicide programs for control of bunch rots and downy mildew in 'Vignoles' grapes, 2008.
Oxidate 1% (v/v): 92% control on grape leaves.

3:SMF031. B. Hed. Penn State Univ. Evaluation of alternative fungicides for control of black rot, powdery mildew, and downy mildew of grapes, 2008.
Serenade at 1%/A + NuFilm P at 0.12%/A (formulation not specified; MAX assumed): 42% control on fruit.
Cueva 1%: 93% control of downy mildew on grapes (fruit).

OMRI-LISTED ALTERNATIVES: CROP GROUP 13: BERRIES: GRAPES / Phomopsis (*Phomopsis viticola*)

Comparative Overview of Efficacy, Hazards, and Use Restrictions
Crop Group 13: Berries and Small Fruits: Grapes / Phomopsis (*Phomopsis viticola*)

NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Synthetic	19	Polyoxin D zinc salt	Oso	68173-4	71	2	See Oso efficacy summary table.	Control.	0	4	None.	May cause dermal sensitization. [F]	Moderately toxic to fish and aquatic invertebrates.	None.
Non-synthetic	44	*Bacillus amylo-liquefaciens* strain D747	Double Nickel 55	70051-108	No data	NA	NA	Control. Preventative only.	0	4	None.	Moderate eye irritation. May cause dermal sensitization. [F]	None.	Water pH restrictions.
Non-synthetic	44	*Bacillus amylo-liquefaciens* strain D747	Double Nickel LC	70051-114	No data	NA	NA	Control. Preventative only.	0	4	None.	Moderate eye irritation. May cause dermal sensitization. [F]	None.	Water pH restrictions.
Non-synthetic	44	*Bacillus amylo-liquefaciens* strain F727	Stargus	84059-28	No data	NA	NA	Control. Preventative only.	0	4	None.	Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Not for sale or use after 18 months from the date of manufacture. Avoid freezing.
Non-synthetic	44	*Bacillus amylo-liquefaciens* strain MBI 600	Serifel	71840-18	No data	NA	NA	Control. Preventative only. Not for use in California.	0	4	None.	Moderate eye irritation. Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	None.
Non-synthetic	44	*Bacillus pumilus* strain QST 2808	Sonata	264-1153	No data	NA	NA	Control. Preventative only.	0	4	None.	Harmful if inhaled. May cause dermal sensitization. [F] Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Spray solution pH restrictions.
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade ASO	264-1152	No data	NA	NA	Control. Preventative only.	0	4	None.	Harmful if inhaled.	None.	None.
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade Max	264-1151	No data	NA	NA	Control. Preventative only.	0	4	None.	May cause dermal sensitization. [F]	None.	None.
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Optiva	264-1160	No data	NA	NA	Control. Preventative only.	0	4	None.	Moderate eye irritation. May cause dermal sensitization. [F]	None.	None.

Comparative Overview of Efficacy, Hazards, and Use Restrictions
Crop Group 13: Berries and Small Fruits: Grapes / Phomopsis (*Phomopsis viticola*)

NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Non-synthetic	P5	*Reynoutria sachalinensis* extract	Regalia	84059-3	No data	NA	NA	Control. Preventative only.	0	4	None.	Moderate eye irritation.	None.	Avoid freezing.
Non-synthetic	NC; Botanical oil	Clove oil, Rosemary oil, Peppermint oil	BacStop	NA; 25(b)	No data	NA	NA	Control.	0	0	None.	Temporary eye and skin irritation	No FIFRA statements.	Storage temperature restrictions.
Synthetic	M1	Copper oxychloride, Copper hydroxide	Badge X2	80289-12	No data	NA	NA	Control.	0	48	Yes.	May be fatal if swallowed. Substantial eye injury.	Toxic to fish and aquatic organisms.	May damage aluminum.
Synthetic	M1	Copper hydroxide	Champ WG	55146-1	No data	NA	NA	Control.	0	48	Yes.	Irreversible eye damage. Harmful if swallowed. May cause dermal sensitization. [F]	Toxic to fish and aquatic organisms.	Damages aluminum.
Synthetic	M1	Copper octanoate	Cueva	67702-2-70051	No data	NA	NA	Control.	0	4	Yes.	Harmful if swallowed or absorbed through skin.	Toxic to fish and aquatic organisms.	Do not store below 4°C (39°F). Tank-mix restrictions.
Synthetic	M1	Copper sulfate pentahydrate	CS 2005	66675-3	No data	NA	NA	Control.	0	48	Yes.	Irreversible eye damage. Skin irritation. Harmful if swallowed, inhaled or absorbed through skin.	Toxic to fish and aquatic organisms.	Incompatible with galvanized pipe and nylon equipment.
Synthetic	M1	Cupric hydroxide	Nu Cop 50 DF	45002-4	No data	NA	NA	Control.	1	24	Yes.	Irreversible eye damage. Harmful if swallowed or absorbed through skin. May cause dermal sensitization. [F]	Toxic to fish and aquatic organisms.	Damages aluminum.
Synthetic	M1	Cupric hydroxide	Nu Cop HB	42750-132	No data	NA	NA	Control.	1	24	Yes.	Irreversible eye damage. Harmful if swallowed or absorbed through skin.	Toxic to fish and aquatic organisms.	Damages aluminum.
Synthetic	M1	Cuprous oxide	Nordox	48142-4	No data	NA	NA	Control.	0	12	Yes.	Harmful if swallowed or absorbed through skin. Eye irritation.	None.	Water pH restrictions.
Synthetic	M2	Sulfur	Acoidal	62562-4	No data	NA	NA	Control.	0	24	Yes.	Harmful if swallowed, inhaled, or absorbed through skin.	Toxic to fish and aquatic organisms.	Suspended dust ignites easily.
Synthetic	M2	Sulfur	Defend DF	62562-8	No data	NA	NA	Control.	0	24	Yes.	Harmful if swallowed, inhaled, or absorbed through skin.	Toxic to fish and aquatic organisms.	Suspended dust ignites easily.
Synthetic	M2	Sulfur	Kumulus DF	51306-352-66330	No data	NA	NA	Control.	0	24	Yes.	Harmful if swallowed. Avoid contact with eyes, skin, and clothing.	None.	Do not store above 104°F.

Comparative Overview of Efficacy, Hazards, and Use Restrictions
Crop Group 13: Berries and Small Fruits: Grapes / Phomopsis (*Phomopsis viticola*)

NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Synthetic	M2	Sulfur	Micro Sulf	55146-75	No data	NA	NA	Control.	0	24	Yes.	Harmful if swallowed, inhaled, or absorbed through skin. Eye irritation.	None.	Keep away from heat, sparks, or flames.
Synthetic	M2	Sulfur	Microthiol Disperss	70506-187	23	1	4:SMF047	Control.	0	24	Yes.	Harmful if swallowed, inhaled, or absorbed through skin.	None.	Do not store near flammable materials.
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Agricure	70870-1	No data	NA	NA	Phomopsis control claim. Mix-and-match directions for use. [E] No specific crop/disease claims.	0	1	None.	Harmful if swallowed. Moderate eye irritation.	None.	Mild alkaline solution; tank-mix restrictions.
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Milstop	70870-1-68539	No data	NA	NA	Phomopsis control claim. Mix-and-match directions for use. [E] No specific crop/disease claims.	0	1	None.	Harmful if swallowed. Moderate eye irritation.	None.	Mild alkaline solution; tank-mix restrictions.

A. FRAC = Fungicide Resistance Action Committee. Products with the same mode of action have the same FRAC Code. NC = Not classified; no FRAC code has been assigned.
B. For Polyoxin D zinc salt (Oso), from summarizes trials, published and unpublished. For OMRI-listed alternatives, from Plant Disease Management Reports (PDMR).
C. Number of trials included in the calculation of the mean.
D. PDMR = Plant Disease Management Reports (on-line journal generally used for publication of efficacy research conducted at universities). Preceded by F&N = Fungicides and Nematicides. https://www.plantmanagementnetwork.org/pub/trial/pdmr/
E. Mix-and-match directions for use. Label has a list of crops and a separate list of diseases with no claim for specific crop/disease combinations.
F. Complete label statement: Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals.
G. EPA relative environmental toxicity descriptors, lowest toxicity to highest toxicity: Practically non-toxic < Moderately toxic < Toxic < Highly toxic.

4:SMF047. W. F. Wilcox *et al.*, Cornell University. Evaluation of fungicide programs for control of Phomopsis in grapes, 2008. Results:
Microthiol Disperse at 5 lb/A; 4 applications beginning at 1-inch shoots:
Shoot infections: 13% control of incidence. 40% control of severity.
Rachis infections: 13% control of incidence. 26% control of girdling.
Trial mean: 23% control (n = 4).

OMRI-LISTED ALTERNATIVES: CROP GROUP 13: BERRIES: GRAPES / Powdery Mildew (*Erisyphe necator*)

Comparative Overview of Efficacy, Hazards, and Use Restrictions Crop Group 13: Berries and Small Fruits: Grapes / Powdery Mildew (*Erisyphe necator*)														
NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Synthetic	19	Polyoxin D zinc salt	Oso	68173-4	79	8	See Oso efficacy summary table.	Control.	0	4	None.	May cause dermal sensitization. [F]	Moderately toxic to fish and aquatic invertebrates.	None.
Non-synthetic	44	*Bacillus amylo-liquefaciens* strain D747	Double Nickel 55	70051-108	No data	NA	NA	Control. Preventative only.	0	4	None.	Moderate eye irritation. May cause dermal sensitization. [F]	None.	Water pH restrictions.
Non-synthetic	44	*Bacillus amylo-liquefaciens* strain D747	Double Nickel LC	70051-114	No data	NA	NA	Control. Preventative only.	0	4	None.	Moderate eye irritation. May cause dermal sensitization. [F]	None.	Water pH restrictions.
Non-synthetic	44	*Bacillus amylo-liquefaciens* strain F727	Stargus	84059-28	No data			Control. Preventative only.	0	4	None.	Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Not for sale or use after 18 months from the date of manufacture. Avoid freezing.
Non-synthetic	44	*Bacillus amylo-liquefaciens* strain MBI 600	Serifel	71840-18	No data	NA	NA	Control. Preventative only. Not for use in California.	0	4	None.	Moderate eye irritation. Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	None.
Non-synthetic	44	*Bacillus mycoides*, isolate J	LifeGard WG	70051-119	No data			No direct effect on plant pathogen; plant protectant; preventative.	0	4	None.	Harmful if inhaled. Moderate eye irritation. Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Store at temperatures below 77°F.
Non-synthetic	44	*Bacillus pumilus* strain QST 2808	Sonata	264-1153	No data	NA	NA	Control. Preventative only.	0	4	None.	Harmful if inhaled. May cause dermal sensitization. [F] Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Spray solution pH restrictions.

Comparative Overview of Efficacy, Hazards, and Use Restrictions Crop Group 13: Berries and Small Fruits: Grapes / Powdery Mildew (*Erisyphe necator*)														
NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Optiva	264-1160	No data	NA	NA	Control. Preventative only.	0	4	None.	Moderate eye irritation. May cause dermal sensitization. [F]	None.	None.
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade ASO	264-1152	34	3	3:SMF031; 1:SMF005.	Control. Preventative only.	0	4	None.	Harmful if inhaled.	None.	None.
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade Max	264-1151	1	1	6:SMF048.	Control. Preventative only.	0	4	None.	May cause dermal sensitization. [F]	None.	None.
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade Optimum	264-1160	No data	NA	NA	Control. Preventative only.	0	4	None.	Moderate eye irritation. May cause dermal sensitization. [F]	None.	None.
Non-synthetic	P5	*Reynoutria sachalinensis* extract	Regalia	84059-3	26	4	8:SMF014; 6:SMF049; 4:SMF054; 4:SMF055.	Control. Preventative only.	0	4	None.	Moderate eye irritation.	None.	Avoid freezing.
Non-synthetic	NC; Biological	*Streptomyces lydicus* WYEC	Actinovate	73314-1	6	2	4:SMF054; 4:SMF055.	Powdery mildew claim. Mix-and-match directions for use. [E] No specific crop/disease claims. Field uses: Control vs suppression only is not specified. Greenhouse uses: Suppression only.	0	1 or until dry	None.	Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Live bacterium. Use and storage temperature restrictions.
Non-synthetic	NC; Botanical oil	Cinnamon oil	Cinnerate	NA; 25(b)	No data	NA	NA	Control.	0	0	None.	Eye and skin irritation. May cause dermal sensitization. [F]	None.	Do not expose to light.
Non-synthetic	NC; Botanical oil	Garlic oil, Cottonseed oil, Corn oil	Mildew Cure	NA; 25(b)	No data	NA	NA	General powdery mildew claim; not crop specific	0	0	None.	Avoid contact with skin, eyes, and clothing.	No FIFRA statement.	None.
Non-synthetic	NC; Botanical oil	Rosemary oil, Clove oil, Thyme oil	Sporatec	NA; 25(b)	No data	NA	NA	Control.	0	0	Yes.	Harmful if swallowed.	Toxic to bees.	Not for use near heat or open flames.
Non-synthetic	NC; Botanical oil	Neem oil	Trilogy	70051-2	No data	NA	NA	Powdery mildew control claim. Mix-and-match directions for use. [E] No specific crop/disease claims.	0	4	Yes.	Moderate eye irritation.	Toxic to fish, aquatic organisms, and bees.	Temperature restrictions. Storage restrictions.

Comparative Overview of Efficacy, Hazards, and Use Restrictions Crop Group 13: Berries and Small Fruits: Grapes / Powdery Mildew (*Erisyphe necator*)														
NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Non-synthetic	NC; Botanical oil	Rosemary oil, Clove oil, Thyme oil	Sporatec	NA; 25(b)	No data	NA	NA	Control.	0	0	Yes.	Harmful if swallowed.	Toxic to bees.	Not for use near heat or open flames.
Non-synthetic	NC; Organic acid	Citric acid	Nuke Em	NA; 25(b)	No data	NA	NA	General mildew claim; not crop specific.	0	0	None.	No FIFRA statement.	No FIFRA statement.	Store away from direct sunlight.
Synthetic	M1	Copper hydroxide	Nu-Cop 50 WP	42002-7	62	1	6:SMF008	Control.	0	24	Yes.	Irreversible eye damage. Harmful if swallowed, absorbed through skin, or inhaled. May cause dermal sensitization. [F]	Toxic to fish and aquatic organisms.	Damages aluminum.
Synthetic	M1	Copper hydroxide	Champ WG	55146-1	No data	NA	NA	Control.	0	48	Yes.	Irreversible eye damage. Harmful if swallowed. May cause dermal sensitization. [F]	Toxic to fish and aquatic organisms.	Damages aluminum.
Synthetic	M1	Copper hydroxide	Nu-Cop HB	42750-132	No data	NA	NA	Control.	1	24	Yes.	Irreversible eye damage. Harmful if swallowed or absorbed through skin.	Toxic to fish and aquatic organisms.	Damages aluminum.
Synthetic	M1	Copper hydroxide, Copper oxychloride	Badge X2	80289-12	50	2	8:SMF014 6:SMF008	Control.	0	48	Yes.	May be fatal if swallowed. Substantial eye injury.	Toxic to fish and aquatic organisms.	May damage aluminum.
Synthetic	M1	Copper octanoate	Cueva	67702-2-70051	19	4	6:SMF048; 3:SMF030; 3:SMF031; 2:SMF004.	Control.	0	4	Yes.	Harmful if swallowed or absorbed through skin.	Toxic to fish and aquatic organisms.	Do not store below 4°C (39°F). Tank-mix restrictions.
Synthetic	M1	Copper sulfate pentahydrate	CS 2005	66675-3	No data	NA	NA	Control.	0	48	Yes.	Irreversible eye damage. Skin irritation. Harmful if swallowed, inhaled or absorbed through skin.	Toxic to fish and aquatic organisms.	Incompatible with galvanized pipe and nylon equipment.
Synthetic	M1	Copper sulfate pentahydrate	Copper Sulfate Crystals	56576-1	No data	NA	NA	Control. Dormant only.	0	24	Yes.	Corrosive. Causes eye damage. Skin irritation.	Toxic to fish.	None.
Synthetic	M1	Cupric hydroxide	Nu-Cop 50 DF	45002-4	No data	NA	NA	Control.	1	24	Yes.	Irreversible eye damage. Harmful if swallowed or absorbed through skin. May cause dermal sensitization. [F]	Toxic to fish and aquatic organisms.	Damages aluminum.
Synthetic	M1	Cuprous oxide	Nordox	48142-4	No data	NA	NA	Control.	0	12	Yes.	Harmful if swallowed or absorbed through skin. Eye irritation.	None.	Water pH restrictions.

Comparative Overview of Efficacy, Hazards, and Use Restrictions Crop Group 13: Berries and Small Fruits: Grapes / Powdery Mildew (*Erisyphe necator*)														
NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Synthetic	M2	Sulfur	Acoidal	62562-4	No data	NA	NA	Control.	0	24	Yes.	Harmful if swallowed, inhaled, or absorbed through skin.	Toxic to fish and aquatic organisms.	Suspended dust ignites easily.
Synthetic	M2	Sulfur	Cosavet-DF	70905-1	No data	NA	NA	Control.	0	24	Yes.	Harmful if swallowed, inhaled, or absorbed through skin. Moderate eye irritation.	None.	Suspended dust ignites easily.
Synthetic	M2	Sulfur	Defend DF	62562-8	No data	NA	NA	Control.	0	24	Yes.	Harmful if swallowed, inhaled, or absorbed through skin.	Toxic to fish and aquatic organisms.	Suspended dust ignites easily.
Synthetic	M2	Sulfur	Kumulus DF	51306-352-66330	No data	NA	NA	Control.	0	24	Yes.	Harmful if swallowed. Avoid contact with eyes, skin, and clothing.	None.	Do not store above 104°F.
Synthetic	M2	Sulfur	Micro Sulf	55146-75	88	1	6:SMF025	Control.	0	24	Yes.	Harmful if swallowed, inhaled, or absorbed through skin. Eye irritation.	None.	Keep away from heat, sparks, or flames.
Synthetic	M2	Sulfur	Microthiol Disperss	70506-187	40	6	6:SMF044; 6:SMF048; 6:SMF049; 4:SMF046; 4:SMF054; 4:SMF055.	Control.	0	24	Yes.	Harmful if swallowed, inhaled, or absorbed through skin.	None.	Do not store near flammable materials.
Synthetic	M2	Sulfur	Thiolux	34704-1079	No data	NA	NA	Control.	0	24	Yes.	Harmful if swallowed, inhaled, or absorbed through skin. Eye irritation.	None.	Suspended dust ignites easily.
Synthetic	NC; Inorganic salt	Potassium bicarbonate	EcoMate Armicarb O	5905-541	No data	NA	NA	Control.	0	4	None.	Harmful if swallowed. Moderate eye irritation.	None.	Avoid contamination by pesticides and fertilizers. Final spray solution pH must be ≥7.0.
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Kaligreen	70231-1	No data	NA	NA	General powdery mildew control claim.	1	4	None.	Harmful if swallowed.	None.	Chemical incompatibilities.
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Milstop	70871-1-68539	0	1	3:SMF030.	Powdery mildew control claim. Mix-and-match directions for use. [E] No specific crop/disease claims.	1	4	None.	Harmful if swallowed. Moderate eye irritation	None.	Chemical incompatibilities.

Comparative Overview of Efficacy, Hazards, and Use Restrictions Crop Group 13: Berries and Small Fruits: Grapes / Powdery Mildew (*Erisyphe necator*)														
NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Synthetic	NC; Inorganic salt	Potassium silicate	Sil-Matrix	82100-1	No data	NA	NA	General powdery mildew control claim. Preventative only.	0	4	None.	Moderate eye irritation.	None	Chemical incompatibilities.
Synthetic	NC; Organic salt	Potassium salts of fatty acids	M-Pede	10163-324	No data	NA	NA	Control.	0	12	Yes.	Substantial eye injury. Skin irritation.	Harmful to aquatic invertebrates	If water has high mineral content, check for compatibility.
Synthetic	NC; Organic salt	Insecticidal soap	Des-X	67702-22-70051	No data	NA	NA	Control.	0	12	Yes.	Substantial eye injury. Skin irritation.	Harmful to aquatic invertebrates	If water has high mineral content, check for compatibility.
Synthetic	NC; Oxidizing agent	Hydrogen dioxide, Peroxyacetic acid	Oxidate	70299-2	No data	NA	NA	Control.	0	Until dry	None.	Irreversible eye damage. May be fatal if swallowed. Skin irritation.	Highly toxic to bees and other beneficial insects. Toxic to fish.	Chemical instabilities. Strong oxidizing agent. Use and storage temperature restrictions.
Synthetic	NC; Oxidizing agent	Hydrogen peroxide, Hydrogen dioxide	Perpose Plus	86729-1	No data	NA	NA	Powdery mildew control claim for all agricultural crops. Preventative only.	0	Until dry	None.	Irreversible eye damage and skin burns. May be fatal if absorbed through skin. Harmful if swallowed.	Toxic to birds, mammals, fish, and aquatic life.	Chemical instabilities. Strong oxidizing agent. Storage restrictions.
Synthetic	NC; Petroleum oil	Mineral oil	Glacial Spray Liquid	34704-849	No data	NA	NA	Control.	0	4	Yes (with sulfur).	Harmful if swallowed, inhaled, or absorbed through skin. Eye irritation. May cause dermal sensitization. [F]	Hazardous to aquatic organisms.	None.
Synthetic	NC; Petroleum oil	Mineral oil	JMS Stylet Oil	65564-1	No data	NA	NA	Control.	0	4	Yes (with sulfur).	Harmful if swallowed.	Toxic to fish.	None.
Synthetic	NC; Petroleum oil	Mineral oil	Omni Supreme Spray	5905-368	No data	NA	NA	Control.	0	12	Yes (with sulfur).	Harmful if absorbed through skin. May cause dermal sensitization. [F]	Toxic to fish and aquatic organisms.	Chemical incompatibilities.
Synthetic	NC; Petroleum oil	Mineral oil	PureSpray Green	69526-9	No data	NA	NA	Control.	0	4	Yes (with sulfur).	Harmful if swallowed or absorbed through skin. May cause dermal sensitization. [F]	Toxic to aquatic organisms.	None.
Synthetic	NC; Petroleum oil	Mineral oil	SuffOil-X	48813-1-68539	No data	NA	NA	Control.	0	4	Yes (with sulfur).	Harmful if swallowed. May cause dermal sensitization. [F]	Toxic to aquatic organisms.	None.
Synthetic	NC; Petroleum oil	Mineral oil	TriTek	48813-1	No data	NA	NA	Control.	0	4	Yes (with sulfur).	Harmful if swallowed or absorbed through skin. May cause dermal sensitization. [F]	Toxic to aquatic organisms.	None.

Comparative Overview of Efficacy, Hazards, and Use Restrictions
Crop Group 13: Berries and Small Fruits: Grapes / Powdery Mildew (*Erisyphe necator*)

NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical

A. FRAC = Fungicide Resistance Action Committee. Products with the same mode of action have the same FRAC Code. NC = Not classified; no FRAC code has been assigned.
B. For Polyoxin D zinc salt (Oso), from summarizes trials, published and unpublished. For OMRI-listed alternatives, from Plant Disease Management Reports (PDMR).
C. Number of trials included in the calculation of the mean.
D. PDMR = Plant Disease Management Reports (on-line journal generally used for publication of efficacy research conducted at universities). Preceded by F&N = Fungicides and Nematicides. https://www.plantmanagementnetwork.org/pub/trial/pdmr/
E. Mix-and-match directions for use. Label has a list of crops and a separate list of diseases with no claim for specific crop/disease combinations.
F. Complete label statement: Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals.
G. EPA relative environmental toxicity descriptors, lowest toxicity to highest toxicity: Practically non-toxic < Moderately toxic < Toxic < Highly toxic.

Plant Disease Management Reports citations and data summaries for non-synthetic alternatives:

8:SMF014. B, Hed, Penn State University. Evaluation of organic fungicides for control of black rot and powdery and downy mildew on Concord grapes, 2013.
Regalia at 6 qt/A: 61% control of powdery mildew on fruit.

6:SMF048. W. F. Wilcox and D. G. Riegel, Cornell University. Evaluation of fungicide programs for control of grapevine powdery mildew, 2010.
Serenade Max: 0% control on leaves. 0% control on leaf area. 0% control on clusters. 5% control on cluster area. Trial mean: 1% control (n = 4).

6:SMF049. W. F. Wilcox and D. G. Riegel, Cornell University. Evaluation of fungicide programs for control of grapevine powdery mildew, 2010.
Regalia at 2 qt/A + Cohere at 0.031% (v/v): 0% control on leaves. 24% control on leaf area. 0% control on clusters. 12% control on cluster area. Trial mean: 9% control (n = 4).

4:SMF054. W. F. Wilcox and D. G. Riegel, Cornell University. Evaluation of fungicide programs for control of grapevine powdery mildew, 2009.
Regalia Max at 0.25% + NuFilm at 0.03%: 0% control on leaves. 25% control on leaf area. 0% control on clusters. 3% control on cluster area. Trial mean: 2% control (n = 4).
Actinovate at 12 oz/A: 0% control on leaves. 4% control on leaf area. 0% control on clusters. 1% control on cluster area. Trial mean: 1% control (n = 4).

4:SMF055. W. F. Wilcox and D. G. Riegel, Cornell University. Evaluation of fungicide programs for control of powdery mildew on Rosette grapes, 2009.
Regalia Max at 0.25% + NuFilm at 0.03%: 0% control on leaves. 56% control on leaf area. 0% control on clusters. 81% control on cluster area. Trial mean: 34% control (n = 4).
Actinovate at 6 oz/A: 0% control on leaves. 6% control on leaf area. 0% control on clusters. 48% control on cluster area.
Actinovate at 12 oz/A: 0% control on leaves. 2% control on leaf area. 0% control on clusters. 24% control on cluster area.
Actinovate trial mean: 10% control (n = 8).

3:SMF030. B. Hed and J. W. Travis, Penn State University. Evaluation of organic fungicides for control of black rot and powdery mildew of Concord grapes, 2008.
Serenade (formulation not specified; ASO assumed) at 1% + NuFilm P 0.12%: 1% control on leaves. 32% control on leaf area. Trial mean: 17% control (n = 2).

3:SMF031. B. Hed and J. W. Travis, Penn State University. Evaluation of alternative fungicides for control of black rot, powdery mildew, and downy mildew of grapes, 2008.
Serenade (formulation not specified; ASO assumed) at 1% + NuFilm P 0.12%: 75% control.

1:SMF005. W. F. Wilcox and D. G. Riegel, Cornell University. Evaluation of fungicide programs for control of grapevine powdery mildew, 2006.
Serenade (formulation not specified; ASO assumed) at 4 qt/A: 0% control on leaves. 18% control on leaf area. 26% control on clusters. 14% control on cluster area. Trial mean: 14% control (n = 4).

Comparative Overview of Efficacy, Hazards, and Use Restrictions
Crop Group 13: Berries and Small Fruits: Grapes / Powdery Mildew (*Erisyphe necator*)

NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical

Plant Disease Management Reports citations and data summaries for synthetic alternatives:

8:SMF014. B, Hed, Penn State University. Evaluation of organic fungicides for control of black rot and powdery and downy mildew on Concord grapes, 2013.
Badge X2 at 1.75 lb/A + lime at 1.75 lb/A, different application timings: 34%, 44%, 55%, and 58% control of powdery mildew on fruit
Badge X2 at 1.75 lb/A + lime at 1.75 lb/A + Nu-Film-P at 0.0625%, different application timings: 47% and 54% control of powdery mildew on fruit.
Trial mean: 40% control (n = 6).

6:SMF008. B. Hed and H. K. Ngugi, Penn State University. Evaluation of conventional and organic fungicides for control of black rot and powdery mildew of Concord grapes, 2011.
NuCop 50 WP at 1 lb/A + Lime at 1 lb/A + NuFilm P at 0.0625%: 86% control of powdery mildew on fruit. 33% control of powdery mildew on leaves.
NuCop 50 WP at 2 lb/A + Lime at 2 lb/A + NuFilm P at 0.0625%: 73% control of powdery mildew on fruit. 56% control of powdery mildew on leaves.
Trial mean: 62% (n = 4).
Badge X2 at 1.75 lb/A + Lime at 1075 lb/A + NuFilm P at 0.0625%: 69% control of powdery mildew on fruit. 49% control of powdery mildew on leaves. Trial mean: 59% (n = 2).

6:SMF025. N. O. Halbrendt, H.K. Ngugi, and J. M. Halbrendst, Penn State University. Performance of organic and conventional programs for powdery mildew management on wine grapes in PA, 2011.
Micro Sulf at 5 lb/A: 10.0%, 99.7%, 94.7%, and 99.7% control on leaves (incidence and severity, respectively; Chamboucin and Traminette, respectively).
Micro Sulf at 5 lb/A: 100%, 100%, 100%, and 100% control on clusters (incidence and severity, respectively; Chamboucin and Traminette, respectively).
Trial mean: 88% (n = 8).

6:SMF044. W. F. Wilcox and D. G. Riegel, Cornell University. Evaluation of fungicide programs for control of grapevine powdery mildew, 2011.
Microthiol 80DF at 5.0 lb/A: 0% control on leaves. 82% control on leaf area. 0% control on clusters. 86% control on cluster area.
Microthiol 80DF at 10.0 lb/A: 4% control on leaves. 88% control on leaf area. 12% control on clusters. 92% control on cluster area.
Trial mean: 46% (n = 8).

6:SMF048. W. F. Wilcox and D. G. Riegel, Cornell University. Evaluation of fungicide programs for control of grapevine powdery mildew, 2010.
Microthiol 80DF at 5.0 lb/A: 0% control on leaves. 62% control on leaf area. 0% control on clusters. 51% control on cluster area.
Microthiol 80DF at 10.0 lb/A: 0% control on leaves. 71% control on leaf area. 14% control on clusters. 90% control on cluster area.
Trial mean: 36% (n = 8).
Cueva at 1.0 % (v/v): 0% control on leaves. 71% control on leaf area. 4% control on clusters. 56% control on cluster area.
Trial mean: 33% (n = 4).

6:SMF049. W. F. Wilcox and D. G. Riegel, Cornell University. Evaluation of fungicide programs for control of grapevine powdery mildew, 2010.
Microthiol 80DF at 5.0 lb/A: 0% control on leaves. 64% control on leaf area. 0% control on clusters. 16% control on cluster area.
Microthiol 80DF at 10.0 lb/A: 0% control on leaves. 77% control on leaf area. 0% control on clusters. 41% control on cluster area.
Trial mean: 25% (n = 8).

5:SMF053. A. M. C. Schilder, J. M. Gillett, *et al*. Michigan State University. Evaluation of fungicides for control of powdery mildew in 'Chardonnay' grapes, 2008.
JMS Stylet Oil 1 gal/A: 12% overall control.

4:SMF046. W. F. Wilcox and D. G. Riegel, Cornell University. Evaluation of fungicide programs for control of powdery mildew on Chardonnay grapes, 2008.
Microthiol 80DF at 5.0 lb/A: 5% control on leaves. 76% control on leaf area. 14% control on clusters. 90% control on cluster area.
Microthiol 80DF at 10.0 lb/A: 17% control on leaves. 91% control on leaf area. 36% control on clusters. 71% control on cluster area.
Trial mean: 50% (n = 8).

4:SMF054. W. F. Wilcox and D. G. Riegel, Cornell University. Evaluation of fungicide programs for control of grapevine powdery mildew, 2009.
Microthiol 80DF at 5.0 lb/A: 0% control on leaves. 70% control on leaf area. 0% control on clusters. 4% control on cluster area.
Microthiol 80DF at 10.0 lb/A: 1% control on leaves. 83% control on leaf area. 0% control on clusters. 93% control on cluster area.
Trial mean: 31% (n = 8).

Comparative Overview of Efficacy, Hazards, and Use Restrictions Crop Group 13: Berries and Small Fruits: Grapes / Powdery Mildew (*Erisyphe necator*)													
NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
4:SMF055. W. F. Wilcox and D. G. Riegel, Cornell University. Evaluation of fungicide programs for control of powdery mildew on Rosette grapes, 2009. Microthiol 80DF at 5.0 lb/A: 0% control on leaves. 74% control on leaf area. 0% control on clusters. 84% control on cluster area. Microthiol 80DF at 10.0 lb/A: 13% control on leaves. 90% control on leaf area. 43% control on clusters. 93% control on cluster area. Trial mean: 50% (n = 8). 3:SMF030. B. Hed and J. W. Travis, Penn State University. Evaluation of organic fungicides for control of black rot and powdery mildew of Concord grapes, 2008. Cueva at 1%: 0% control. More disease than in the untreated control. Milstop at 2.5 lb/A and 5 lb/A: 0% control. Same as the untreated control. 3:SMF031. B. Hed and J. W. Travis, Penn State University. Evaluation of alternative fungicides for control of black rot, powdery mildew, and downy mildew of grapes, 2008. Cueva at 1%: 0% control. More disease than in the untreated control. 2:SMF004. B. Hed and J. W. Travis, Penn State University. Evaluation of organic fungicides for control of black rot and powdery mildew of Concord grapes, 2007. Cueva at 1 gal/A: 26% and 39% control (fruit and rachis, respectively). Cueva at 2 gal/A: 60% and 47% control (fruit and rachis, respectively). Trial mean: 43% (n = 4). Older studies are not cited and summarized.													

OMRI-LISTED ALTERNATIVES: CROP GROUP 13: BERRIES AND SMALL FRUITS: STRAWBERRIES / Anthracnose Fruit Rot (*Colletotrichum acutatum*)

Comparative Overview of Efficacy, Hazards, and Use Restrictions Crop Group 13: Berries and Small Fruits: Strawberries / Anthracnose Fruit Rot (*Colletotrichum acutatum*)														
NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Synthetic	19	Polyoxin D zinc salt	Oso	68173-4	86	2	See Oso efficacy summary table.	Control.	0	4	None.	May cause dermal sensitization. [F]	Moderately toxic to fish and aquatic invertebrates.	None.
Non-synthetic	44	*Bacillus amylo-liquefaciens* strain D747	Double Nickel 55	70051-108	No data	NA	NA	Control. Preventative only.	0	4	None.	Moderate eye irritation. May cause dermal sensitization. [F]	None.	Water pH restrictions.
Non-synthetic	44	*Bacillus amylo-liquefaciens* strain D747	Double Nickel LC	70051-114	No data	NA	NA	Control. Preventative only.	0	4	None.	Moderate eye irritation. May cause dermal sensitization. [F]	None.	Water pH restrictions.
Non-synthetic	44	*Bacillus amylo-liquefaciens* strain MBI 600	Serifel	71840-18	No data	NA	NA	Control. Preventative only.	0	4	None.	Moderate eye irritation. Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	None.
Non-synthetic	44	*Bacillus pumilus* strain QST 2808	Sonata	264-1153	No data	NA	NA	Control. Preventative only.	0	4	None.	Harmful if inhaled. May cause dermal sensitization. [F] Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None	Spray solution pH restrictions.
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade ASO	264-1152	No data	NA	NA	Control. Preventative only.	0	4	None.	Harmful if inhaled.	None.	None.
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade Optimum	264-1160	No data	NA	NA	Control. Preventative only. Not for use in California.	0	4	None.	Moderate eye irritation. May cause dermal sensitization. [F]	None.	None.
Non-synthetic	P5	*Reynoutria sachalinensis* extract	Regalia	84059-3	No data	NA	NA	Suppression only. Preventative only.	0	4	None.	Moderate eye irritation.	None.	Avoid freezing.

Comparative Overview of Efficacy, Hazards, and Use Restrictions
Crop Group 13: Berries and Small Fruits: Strawberries / Anthracnose Fruit Rot (*Colletotrichum acutatum*)

NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Non-synthetic	NC; Biological	*Aureobasidium pullulans* strains DSM 14940 and DSM 14941	Botector	86174-3	No data	NA	NA	Control. Preventative only.	0	4	None.	Harmful if swallowed or absorbed through skin. Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Live yeast-like fungus. Use and storage temperature restrictions. Not compatible with many fungicides.
Non-synthetic	NC; Biological	*Streptomyces lydicus* WYEC	Actinovate	73314-1	12	4	9:SMF007; 3:SMF019; 3:SMF023; 2:SMF045.	Anthracnose claim. Mix-and-match directions for use. [E] No specific crop/disease claims. Field uses: Control vs suppression only is not specified. Greenhouse uses: Suppression only.	0	1 or until dry	None.	Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Live bacterium. Use and storage temperature restrictions.
Non-synthetic	NC; Botanical oil	Rosemary oil, Clove oil, Thyme oil	Sporatec	NA; 25(b)	No data	NA	NA	Control.	0	0	Yes.	Harmful if swallowed.	Toxic to bees.	Not for use near heat or open flames.
Synthetic	M1	Copper octanoate	Cueva	67702-25-70051	No data	NA	NA	Control.	0	4	Yes.	Harmful if swallowed or absorbed through skin.	Toxic to fish and aquatic organisms.	Do not store below 4°C (39°F). Tank-mix restrictions.
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Agricure	70870-1	No data	NA	NA	Anthracnose control claim. Mix-and-match directions for use. [E] No specific crop/disease claims.	0	1	None.	Harmful if swallowed. Moderate eye irritation.	None.	Mild alkaline solution; tank-mix restrictions.
Synthetic	NC; Inorganic salt	Potassium bicarbonate	EcoMate Armicarb O	5905-541	No data	NA	NA	Control.	0	4	None.	Harmful if swallowed. Moderate eye irritation.	None.	Avoid contamination by pesticides and fertilizers. Final spray solution pH must be ≥7.0.
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Milstop	70870-1-68539	No data	NA	NA	Anthracnose control claim. Mix-and-match directions for use. [E] No specific crop/disease claims.	0	1	None.	Harmful if swallowed. Moderate eye irritation.	None.	Mild alkaline solution; tank-mix restrictions.

Comparative Overview of Efficacy, Hazards, and Use Restrictions
Crop Group 13: Berries and Small Fruits: Strawberries / Anthracnose Fruit Rot (*Colletotrichum acutatum*)

NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Synthetic	NC; Oxidizing agent	Hydrogen peroxide, Hydrogen dioxide	Perpose Plus	86729-1	No data	NA	NA	Anthracnose control claim for all agricultural crops. Preventative only.	0	Until dry	None.	Irreversible eye damage and skin burns. May be fatal if absorbed through skin. Harmful if swallowed.	Toxic to birds, mammals, fish, and aquatic life.	Chemical instabilities. Strong oxidizing agent. Storage restrictions.

A. FRAC = Fungicide Resistance Action Committee. Products with the same mode of action have the same FRAC Code. NC = Not classified; no FRAC code has been assigned.
B. For Polyoxin D zinc salt (Oso), from summarizes trials, published and unpublished. For OMRI-listed alternatives, from Plant Disease Management Reports (PDMR).
C. Number of trials included in the calculation of the mean.
D. PDMR = Plant Disease Management Reports (on-line journal generally used for publication of efficacy research conducted at universities). Preceded by F&N = Fungicides and Nematicides. https://www.plantmanagementnetwork.org/pub/trial/pdmr/
E. Mix-and-match directions for use. Label has a list of crops and a separate list of diseases with no claim for specific crop/disease combinations.
F. Complete label statement: Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals.
G. EPA relative environmental toxicity descriptors, lowest toxicity to highest toxicity: Practically non-toxic < Moderately toxic < Toxic < Highly toxic.

Plant Disease Management Reports citations and data summaries:

9:SMF007. J. Mertely et al. Univ. Of Florida. Evaluation of products for anthracnose and Botrytis fruit rot control in annual strawberry, 2013-14.
Actinovate at 6 oz/A: 8% control of Anthracnose incidence.

3:SMF019. M. Rahman et al. North Carolina State Univ. Evaluation of fungicides to control anthracnose fruit rot on strawberry cultivar Chandler, 2008.
Actinovate WTEC at 108 (units?)/: 15% control of Anthracnose incidence.

3:SMF023. H. Su and W.D. Dubler. University of California. Fungicide control of Botrytis and anthracnose fruit rot on strawberry in California, 2008—trial II.
Actinovate at 6 oz/A: 28% control of Anthracnose incidence.

2:SMF045. J. Mertely et al. Univ. Of Florida. Evaluation of fungicides to control anthracnose fruit rot in annual strawberry, 2007-08.
Actinovate at 12 oz/A: 7% control of Anthracnose incidence.

OMRI-LISTED ALTERNATIVES: CROP GROUP 13: BERRIES AND SMALL FRUITS: STRAWBERRIES / Gray Mold (*Botrytis cinerea*)

Comparative Overview of Efficacy, Hazards, and Use Restrictions
Crop Group 13: Berries and Small Fruits: Strawberries / Gray Mold (*Botrytis cinerea*)

NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Synthetic	19	Polyoxin D zinc salt	Oso	68173-4	61	5	See Oso efficacy summary table.	Control.	0	4	None.	May cause dermal sensitization. [F]	Moderately toxic to fish and aquatic invertebrates.	None.
Non-synthetic	44	*Bacillus amylo-liquefaciens* strain D747	Double Nickel 55	70051-108	No data	NA	NA	Suppression only. Preventative only.	0	4	None.	Moderate eye irritation. May cause dermal sensitization. [F]	None.	Water pH restrictions.
Non-synthetic	44	*Bacillus amylo-liquefaciens* strain D747	Double Nickel LC	70051-114	2	2	9:SMF021; 9:SMF035.	Suppression only. Preventative only.	0	4	None.	Moderate eye irritation. May cause dermal sensitization. [F]	None.	Water pH restrictions.
Non-synthetic	44	*Bacillus amylo-liquefaciens* strain F727	Stargus	84059-28	No data	NA	NA	Control. Preventative only. Not for use in California.	0	4	None.	Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Not for sale or use after 18 months from the date of manufacture. Avoid freezing.
Non-synthetic	44	*Bacillus amylo-liquefaciens* strain MBI 600	Serifel	71840-18	No data	NA	NA	Control. Preventative only.	0	4	None.	Moderate eye irritation. Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	None.
Non-synthetic	44	*Bacillus pumilus* strain QST 2808	Sonata	264-1153	No data	NA	NA	Control. Preventative only.	0	4	None.	Harmful if inhaled. May cause dermal sensitization. [F] Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Spray solution pH restrictions.
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Optiva	264-1160	No data	NA	NA	Suppression only. Preventative only.	0	4	None.	Moderate eye irritation. May cause dermal sensitization. [F]	None.	None.
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade ASO	264-1152	0	1	9:SMF021.	Suppression only. Preventative only.	0	4	None.	Harmful if inhaled.	None.	None.
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade Max	264-1151	19	1	F&N 59:SMF030.	Suppression only. Preventative only.	0	4	None.	May cause dermal sensitization. [F]	None.	None.

Comparative Overview of Efficacy, Hazards, and Use Restrictions
Crop Group 13: Berries and Small Fruits: Strawberries / Gray Mold (*Botrytis cinerea*)

NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade Optimum	264-1160	16	5	11:SMF002; 10:SMF040; 9:SMF021; 9:SMF035; 8:SMF028.	Suppression only. Preventative only.	0	4	None.	Moderate eye irritation. May cause dermal sensitization. [F]	None.	None.
Non-synthetic	P5	*Reynoutria sachalinensis* extract	Regalia	84059-3	2	2	11:SMF022; 9:SMF035.	Control. Preventative only.	0	4	None.	Moderate eye irritation.	None.	Avoid freezing.
Non-synthetic	NC; Bio-chemical	Rhamnolipid biosurfactant	Zonix	72431-1	No data			Botrytis control claim. Mix-and-match directions for use. [E] No specific crop/disease claims. Preventative use only.	0	4	None.	Irreversible eye damage.	None.	Do not use at ambient temperatures over 80°F. Keep from overheating or freezing. Store out of direct sunlight.
Non-synthetic	NC; Biological	*Aureobasidium pullulans* strains DSM 14940 and DSM 14941	Botector	86174-3	No data	NA	NA	Control. Preventative only.	0	4	None.	Harmful if swallowed or absorbed through skin. Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Live yeast-like fungus. Use and storage temperature restrictions. Not compatible with many fungicides.
Non-synthetic	NC; Biological	*Gliocladium catenulatum* strain J1446	Prestop	64137-11	0	1	11:SMF022	Botrytis claim. Mix-and-match directions for use. [E] No specific crop/disease claims.	0	0	None.	Harmful if swallowed. Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Live organism. Store refrigerated. Tank-mix restrictions.
Non-synthetic	NC; Biological	*Streptomyces lydicus*	Actinovate AG	73314-1	17	3	11:SMF002; 9:SMF021; 3:SMF014.	Botrytis control claim. Mix-and-match directions for use. [E] No specific crop/disease claims. Field uses: Control vs suppression only is not specified. Greenhouse uses: Suppression only.	0	1 or until dry	None.	Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Live bacterium. Use and storage temperature restrictions.

Comparative Overview of Efficacy, Hazards, and Use Restrictions
Crop Group 13: Berries and Small Fruits: Strawberries / Gray Mold (*Botrytis cinerea*)

NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Non-synthetic	NC; Botanical oil	Cinnamon oil	Cinnerate	NA; 25(b)	No data	NA	NA	Control.	0	0	None.	Eye and skin irritation. May cause dermal sensitization. [F]	None.	Do not expose to light.
Non-synthetic	NC; Botanical oil	Clove oil, Rosemary oil, Peppermint oil	BacStop	NA; 25(b)	No data	NA	NA	Control.	0	0	None.	Temporary eye and skin irritation	No FIFRA statements.	Storage temperature restrictions.
Non-synthetic	NC; Botanical oil	Rosemary oil, Clove oil, Thyme oil	Sporatec	NA; 25(b)	No data	NA	NA	Control.	0	0	Yes.	Harmful if swallowed.	Toxic to bees.	Not for use near heat or open flames.
Non-synthetic	NC; Botanical oil	Neem oil	Trilogy	70051-2	No data	NA	NA	Botrytis control claim. Mix-and-match directions for use. [E] No specific crop/disease claims.	0	4	Yes.	Moderate eye irritation.	Toxic to fish, aquatic organisms, and bees.	Temperature restrictions. Storage restrictions.
Synthetic	M1	Copper octanoate	Cueva	67702-2-70051	0	1	9:SMF035.	Control.	0	4	Yes.	Harmful if swallowed or absorbed through skin.	Toxic to fish and aquatic organisms.	Do not store below 4°C (39°F). Tank-mix restrictions.
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Agricure	70870-1	No data	NA	NA	Botrytis control claim. Mix-and-match directions for use. [E] No specific crop/disease claims.	0	1	None.	Harmful if swallowed. Moderate eye irritation.	None.	Mild alkaline solution; tank-mix restrictions.
Synthetic	NC; Inorganic salt	Potassium bicarbonate	EcoMate Armicarb O	5905-541	No data	NA	NA	Control.	0	4	None.	Harmful is swallowed. Moderate eye irritation.	None.	Avoid contamination by pesticides and fertilizers. Final spray solution pH must be ≥7.0.
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Milstop	70870-1-68539	No data	NA	NA	Botrytis control claim. Mix-and-match directions for use. [E] No specific crop/disease claims.	0	1	None.	Harmful is swallowed. Moderate eye irritation.	None.	Mild alkaline solution; tank-mix restrictions.
Synthetic	NC; Oxidizing agent	Hydrogen dioxide, Peroxyacetic acid	Oxidate 2.0	70299-2	4	3	9:SMF021; F&N 59:SMF033; F&N 59:SMF048.	Control.	0	Until dry	None.	Irreversible eye damage. May be fatal if swallowed. Skin irritation.	Highly toxic to bees and other beneficial insects. Toxic to fish.	Chemical instabilities. Strong oxidizing agent. Use and storage temperature restrictions.

Comparative Overview of Efficacy, Hazards, and Use Restrictions
Crop Group 13: Berries and Small Fruits: Strawberries / Gray Mold (*Botrytis cinerea*)

NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Synthetic	NC; Oxidizing agent	Hydrogen peroxide, Hydrogen dioxide	Perpose Plus	86729-1	No data	NA	NA	Botrytis control claim for all agricultural crops. Preventative only.	0	Until dry	None.	Irreversible eye damage and skin burns. May be fatal if absorbed through skin. Harmful if swallowed.	Toxic to birds, mammals, fish, and aquatic life.	Chemical instabilities. Strong oxidizing agent. Storage restrictions.
Synthetic	NC; Petroleum oil	Mineral oil	JMS Stylet Oil	65564-1	No data	NA	NA	Control.	0	4	Yes (with sulfur).	Harmful if swallowed.	Toxic to fish.	None.
Synthetic	NC; Petroleum oil	Mineral oil	PureSpray Green	69526-9	No data	NA	NA	Control.	0	4	Yes (with sulfur).	Harmful if swallowed or absorbed through skin. May cause dermal sensitization. [F]	Toxic to aquatic organisms.	None.

A. FRAC = Fungicide Resistance Action Committee. Products with the same mode of action have the same FRAC Code. NC = Not classified; no FRAC code has been assigned.
B. For Polyoxin D zinc salt (Oso), from summarizes trials, published and unpublished. For OMRI-listed alternatives, from Plant Disease Management Reports (PDMR).
C. Number of trials included in the calculation of the mean.
D. PDMR = Plant Disease Management Reports (on-line journal generally used for publication of efficacy research conducted at universities). Preceded by F&N = Fungicides and Nematicides. https://www.plantmanagementnetwork.org/pub/trial/pdmr/
E. Mix-and-match directions for use. Label has a list of crops and a separate list of diseases with no claim for specific crop/disease combinations.
F. Complete label statement: Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals.
G. EPA relative environmental toxicity descriptors, lowest toxicity to highest toxicity: Practically non-toxic < Moderately toxic < Toxic < Highly toxic.

Comparative Overview of Efficacy, Hazards, and Use Restrictions
Crop Group 13: Berries and Small Fruits: Strawberries / Gray Mold (*Botrytis cinerea*)

NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical

Plant Disease Management Reports citations and data summaries for non-synthetic alternatives.

11:SMF002. R. C. Brantley, K.L. Ivors, and G. J. Holmes, California Polytechnic State University. Evaluation of biofungicides for Botrytis fruit rot management on strawberries, 2016.
Actinovate SP at 6 oz/A: No control of Botrytis fruit rot incidence for the season.
Actinovate SP at 12 oz/A: No control of Botrytis fruit rot incidence for the season.
Serenade Optimum at 20 oz/A: No control of Botrytis fruit rot incidence for the season.

11:SMF022. L. Cordova, A. Zuniga, *et al.*, University of Florida. Evaluation of biorational products for control of Botrytis fruit rot in annual strawberry, 2016-17.
Regalia at 52 fl oz/A: 3% control of Botrytis fruit rot for the season.
Prestop WG at 12.5 oz/A: No control of Botrytis fruit rot for the season. Botrytis fruit rot incidence was higher than in the untreated control.

10:SMF040. L. Cordova, J. Mertely, and N.A. Peres, University of Florida. Evaluation of biorational products for control of Botrytis fruit rot in annual strawberry, 2015-2016.
Serenade Optimum at 16 oz/A weekly: 38% control of Botrytis incidence on fruit during the growing season.
Serenade Optimum at 16 oz/A twice weekly: 62% control of Botrytis incidence on fruit during the growing season.
Trial mean: 50% control (n = 2).

9:SMF021. L. Cordova, J. Mertely, and N.A. Peres, University of Florida. Evaluation of biorational products for control of Botrytis fruit rot in annual strawberry, 2014-2015.
Actinovate 6 oz/A: No control of Botrytis Fruit rot. More Botrytis than in the untreated control for the season.
Double Nickel (formulation not specified; LC assumed) at 1.5 qt/A : 4% control of Botrytis fruit rot for the season.
Regalia at 2 qt/A: 9% control of Botrytis fruit rot for the season.
Serenade ASO at 4 qt/A: No control of Botrytis fruit rot. More Botrytis than in the untreated control for the season.
Serenade Optimum at 1 lb/A: 5% control of Botrytis fruit rot for the season.

9:SMF035. A. M. Schilder. J. M. Gillett, and R. W. Sysak, Michigan State University. Evaluation of organic fungicides for control of strawberry foliar and fruit diseases, 2014.
Double Nickel LC at 1 gal/acre: No control. More post-harvest Botrytis than in the untreated control.
Serenade Optimum at 20 oz/A + NuFilm P at 0.125% (v/v): No control. More post-harvest Botrytis than in the untreated control.
Regalia at 2 qt/acre: No control. More post-harvest Botrytis than in the untreated control.

8:SMF028. L. Cordova, A. Zuniga, *et al.*, University of Florida. Evaluation of products for the control of Botrytis fruit rot in annual strawberry, 2013-14.
Serenade Optimum at 20 fl oz/A: 13% control of Botrytis at peak period. 34% control of Botrytis for season. Trial mean: 24% control (n = 2).

3:SMF014. J. Mertley, T. Seijo, *et al.*, University of Florida. Evaluation of fungicides for control of Botrytis and other fruit rots in annual strawberry, 2007-08.
Actinovate at 12 oz/A at 7-day intervals: 52% control of Botrytis incidence. (6% incidence in the untreated control; low disease pressure.)

F&N 59:SMF030. A. M. Schilder. J. M. Gillett, and R. W. Sysak, Michigan State University. Evaluation of fungicides for control of foliar and fruit diseases of strawberry, 2003.
Serenade (formulation not specified; Max assumed based upon units) at 8 lb/A: 49%, 9.1% and No control (at 3 harvest times). Trial mean = 19% control (n = 3).

Data for trials with very low disease pressure in the untreated control are not summarized (F&N 60:SMF021, 1:SMF028).

Comparative Overview of Efficacy, Hazards, and Use Restrictions
Crop Group 13: Berries and Small Fruits: Strawberries / Gray Mold (*Botrytis cinerea*)

NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical

Plant Disease Management Reports citations and data summaries for synthetic alternatives.

9:SMF021. L. Cordova, J. Mertely, and N. A. Peres, University of Florida. Evaluation of biorational products for control of Botrytis fruit rot in annual strawberry, 2014-2015.
Oxidate at 128 fl oz/A: No control of Botrytis fruit rot incidence for the season. More disease than in the untreated control.

9:SMF035. A. M. Schilder. J. M. Gillett, and R. W. Sysak, Michigan State University. Evaluation of organic fungicides for control of strawberry foliar and fruit diseases, 2014.
Cueva at 1 gal/acre: No control. More post-harvest Botrytis than in the untreated control.

F&N 59:SMF033. W. W. Turechek, N.A. Werner, and M.C. Heidenreich, Cornell University. Evaluation of fungicides for control of Botrytis fruit rot on strawberry, 2003.
Oxidate at 128 fl oz/A: No control post-harvest. More Botrytis than in the untreated control.

F&N 59:SMF048. F. J. Louws and J. G. Driver, North Carolina Stat University. Evaluation of fungicides for anthracnose fruit rot and gray mold management, 2003.
Oxidate at 128 fl oz/100 gal and 128 fl oz/300 gal: 11% control of Botrytis.

Data for trials with very low disease pressure in the untreated control are not summarized (F&N 60:SMF021, 1:SMF028).

OMRI-LISTED ALTERNATIVES: CROP GROUP 13: BERRIES: STRAWBERRIES / Leather Rot (*Phytophthora cactorum*)

Comparative Overview of Efficacy, Hazards, and Use Restrictions
Crop Group 13: Berries and Small Fruits: Strawberries / Leather Rot (*Phytophthora cactorum*)

NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Synthetic	19	Polyoxin D zinc salt	Oso	68173-4	86	2	See Oso efficacy summary table.	Control.	0	4	None.	May cause dermal sensitization. [F]	Moderately toxic to fish and aquatic invertebrates.	None.
Non-synthetic	BM2	*Trichoderma asperellum*, *Trichoderma gamsii*	Bio-Tam	80289-9	No data.	NA	NA	Phytophthora control claim. Mix-and-match directions for use. [E] No specific crop/disease claims. Preventative only.	0	1	None.	Harmful if absorbed through skin or swallowed.	Toxic to beneficial beetle species.	Use and storage temperature restrictions.15-month shelf-life.
Non-synthetic	BM2	*Trichoderma harzianum* strain R-22, *Trichoderma virens* strain G41	Rootshield Plus+ Granules	68539-10	No data.	NA	NA	Phytophthora control claim. Mix-and-match directions for use. [E] No specific crop/disease claims. Preventative only.	0	0	None.	Moderate eye irritation. Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Live spores. Use temperature restrictions. Store refrigerated.
Non-synthetic	BM2	*Trichoderma harzianum* strain R-22, *Trichoderma virens* strain G41	Rootshield Plus+ WP	68539-9	No data.	NA	NA	Phytophthora control claim. Mix-and-match directions for use. [E] No specific crop/disease claims. Preventative only.	0	4	None.	Moderate eye irritation. Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Live spores. Use temperature restrictions. Store refrigerated.
Non-synthetic	NC; Biological	*Aureobasidium pullulans* strains DSM 14940 and DSM 14941	Botector	86174-3	No data	NA	NA	Control. Preventative only.	0	4	None.	Harmful if swallowed or absorbed through skin. Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Live yeast-like fungus. Use and storage temperature restrictions. Not compatible with many fungicides.
Non-synthetic	NC; Biological	*Gliocladium catenulatum*	Prestop	64137-11	No data.	NA	NA	Soil treatment only.	0	0	None.	Harmful if swallowed. Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Live organism. Store refrigerated. Tank-mix restrictions.

Comparative Overview of Efficacy, Hazards, and Use Restrictions
Crop Group 13: Berries and Small Fruits: Strawberries / Leather Rot (*Phytophthora cactorum*)

NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical

A. FRAC = Fungicide Resistance Action Committee. Products with the same mode of action have the same FRAC Code. NC = Not classified; no FRAC code has been assigned.
B. For Polyoxin D zinc salt (Oso), from summarizes trials, published and unpublished. For OMRI-listed alternatives, from Plant Disease Management Reports (PDMR).
C. Number of trials included in the calculation of the mean.
D. PDMR = Plant Disease Management Reports (on-line journal generally used for publication of efficacy research conducted at universities). Preceded by F&N = Fungicides and Nematicides. https://www.plantmanagementnetwork.org/pub/trial/pdmr/
E. Mix-and-match directions for use. Label has a list of crops and a separate list of diseases with no claim for specific crop/disease combinations.
F. Complete label statement: Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals.
G. EPA relative environmental toxicity descriptors, lowest toxicity to highest toxicity: Practicaly non-toxic < Moderately toxic < Toxic < Highly toxic.

OMRI-LISTED ALTERNATIVES: CROP GROUP 13: BERRIES: STRAWBERRIES / Phomopsis Leaf Spot (Blight) (*Phomopsis obscurans*)

Comparative Overview of Efficacy, Hazards, and Use Restrictions Crop Group 13: Berries and Small Fruits: Strawberries / Phomopsis Leaf Spot (Blight) (*Phomopsis obscurans*)														
NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Synthetic	19	Polyoxin D zinc salt	Oso	68173-4	91	2	See Oso efficacy summary table.		0	4	None.	May cause dermal sensitization. [F]	Moderately toxic to fish and aquatic invertebrates.	None.
Non-synthetic	P5	*Reynoutria sachalinensis* extract	Regalia	84059-3	54	1	9:SMF035	Control.	0	4	None.	Moderate eye irritation.	None.	Avoid freezing.
Non-synthetic	NC; Biological	*Aureobasidium pullulans* strains DSM 14940 and DSM 14941	Botector	86174-3	No data	NA	NA	Control. Preventative only.	0	4	None.	Harmful if swallowed or absorbed through skin. Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Live yeast-like fungus. Use and storage temperature restrictions. Not compatible with many fungicides.
Synthetic	M1	Copper octanoate	Cueva	67702-2-70051	94	1	9:SMF035	Control.	0	4	Yes.	Harmful if swallowed or absorbed through skin.	Toxic to fish and aquatic organisms.	Do not store below 4°C (39°F). Tank-mix restrictions.
Synthetic	M1	Cupric hydroxide	Nu-Cop 50 DF	45002-4	No data	NA	NA	Control.	1	24	Yes.	Irreversible eye damage. Harmful if swallowed or absorbed through skin. May cause dermal sensitization. [F]	Toxic to fish and aquatic organisms.	Damages aluminum.
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Agricure	70870-1	No data	NA	NA	Phomopsis control claim. Leaf vs fruit not specified. Mix-and-match directions for use. [E] No specific crop/disease claims.	0	1	None.	Harmful if swallowed. Moderate eye irritation.	None.	Mild alkaline solution; tank-mix restrictions.
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Milstop	70870-1-68539	No data	NA	NA	Phomopsis control claim. Leaf vs fruit not specified. Mix-and-match directions for use. [E] No specific crop/disease claims.	0	1	None.	Harmful if swallowed. Moderate eye irritation.	None.	Mild alkaline solution; tank-mix restrictions.

Comparative Overview of Efficacy, Hazards, and Use Restrictions
Crop Group 13: Berries and Small Fruits: Strawberries / Phomopsis Leaf Spot (Blight) (*Phomopsis obscurans*)

NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical

A. FRAC = Fungicide Resistance Action Committee. Products with the same mode of action have the same FRAC Code. NC = Not classified; no FRAC code has been assigned.
B. For Polyoxin D zinc salt (Oso), from summarizes trials, published and unpublished. For OMRI-listed alternatives, from Plant Disease Management Reports (PDMR).
C. Number of trials included in the calculation of the mean.
D. PDMR = Plant Disease Management Reports (on-line journal generally used for publication of efficacy research conducted at universities). Preceded by F&N = Fungicides and Nematicides. https://www.plantmanagementnetwork.org/pub/trial/pdmr/
E. Mix-and-match directions for use. Label has a list of crops and a separate list of diseases with no claim for specific crop/disease combinations.
F. Complete label statement: Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals.
G. EPA relative environmental toxicity descriptors, lowest toxicity to highest toxicity: Practically non-toxic < Moderately toxic < Toxic < Highly toxic.

Plant Disease Management Reports citations and data summaries:

9:SMF035. A. Schilder *et al.*, Michigan State University. Evaluation of organic fungicides for control of strawberry foliar and fruit diseases, 2014.
Regalia at 2 qt/A: 54% control of Phomopsis leaf blight.
Cueva at 1 gal/A: 94% control of Phomopsis leaf blight.

OMRI-LISTED ALTERNATIVES: CROP GROUP 13: BERRIES: STRAWBERRIES / Phomopsis Fruit Rot (Soft Rot) (*Phomopsis obscurans*)

Comparative Overview of Efficacy, Hazards, and Use Restrictions
Crop Group 13: Berries and Small Fruits: Strawberries / Phomopsis Fruit Rot (*Phomopsis obscurans*)

NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Synthetic	19	Polyoxin D zinc salt	Oso	68173-4	80	1	See Oso efficacy summary table.		0	4	None.	May cause dermal sensitization. [F]	Moderately toxic to fish and aquatic invertebrates.	None.
Non-synthetic	NC; Biological	*Aureobasidium pullulans* strains DSM 14940 and DSM 14941	Botector	86174-3	No data	NA	NA	Control. Preventative only.	0	4	None.	Harmful if swallowed or absorbed through skin. Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Live yeast-like fungus. Use and storage temperature restrictions. Not compatible with many fungicides.
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Agricure	70870-1	No data	NA	NA	Phomopsis control claim. Leaf vs fruit not specified. Mix-and-match directions for use. [E] No specific crop/disease claims.	0	1	None.	Harmful if swallowed. Moderate eye irritation.	None.	Mild alkaline solution; tank-mix restrictions.
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Milstop	70870-1-68539	No data	NA	NA	Phomopsis control claim. Leaf vs fruit not specified. Mix-and-match directions for use. [E] No specific crop/disease claims.	0	1	None.	Harmful if swallowed. Moderate eye irritation.	None.	Mild alkaline solution; tank-mix restrictions.

A. FRAC = Fungicide Resistance Action Committee. Products with the same mode of action have the same FRAC Code. NC = Not classified; no FRAC code has been assigned.
B. For Polyoxin D zinc salt (Oso), from summarizes trials, published and unpublished. For OMRI-listed alternatives, from Plant Disease Management Reports (PDMR).
C. Number of trials included in the calculation of the mean.
D. PDMR = Plant Disease Management Reports (on-line journal generally used for publication of efficacy research conducted at universities). Preceded by F&N = Fungicides and Nematicides. https://www.plantmanagementnetwork.org/pub/trial/pdmr/
E. Mix-and-match directions for use. Label has a list of crops and a separate list of diseases with no claim for specific crop/disease combinations.
F. Complete label statement: Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals.
G. EPA relative environmental toxicity descriptors, lowest toxicity to highest toxicity: Practically non-toxic < Moderately toxic < Toxic < Highly toxic.

OMRI-LISTED ALTERNATIVES: CROP GROUP 13: BERRIES: STRAWBERRIES / Powdery Mildew (*Podosphaera aphanis*)

Comparative Overview of Efficacy, Hazards, and Use Restrictions Crop Group 13: Berries and Small Fruits: Strawberries / Powdery Mildew (*Podosphaera aphanis*, *Sphacelotheca* sp.)														
NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Synthetic	19	Polyoxin D zinc salt	Oso	68173-4	66	3	See Oso efficacy summary table.		0	4	None.	May cause dermal sensitization. [F]	Moderately toxic to fish and aquatic invertebrates.	None.
Non-synthetic	44	*Bacillus amylo-liquefaciens* strain D747	Double Nickel 55	70051-108	No data	NA	NA	Suppression only. Preventative only.	0	4	None.	Moderate eye irritation. May cause dermal sensitization. [F]	None.	Water pH restrictions.
Non-synthetic	44	*Bacillus amylo-liquefaciens* strain D747	Double Nickel LC	70051-114	No data	NA	NA	Suppression only. Preventative only.	0	4	None.	Moderate eye irritation. May cause dermal sensitization. [F]	None.	Water pH restrictions.
Non-synthetic	44	*Bacillus amylo-liquefaciens* strain MBI 600	Serifel	71840-18	No data	NA	NA	Control. Preventative only.	0	4	None.	Moderate eye irritation. Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	None.
Non-synthetic	44	*Bacillus pumilus* strain QST 2808	Sonata	264-1153	No data	NA	NA	Control. Preventative only.	0	4	None.	Harmful if inhaled. May cause dermal sensitization. [F] Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Spray solution pH restrictions.
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade ASO	264-1152	No data	NA	NA	Suppression only. Preventative only.	0	4	None.	Harmful if inhaled.	None.	None.
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade Max	264-1151	2	1	3:SMF016.	Suppression only. Preventative only.	0	4	None.	May cause dermal sensitization. [F]	None.	None.
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade Optimum	264-1160	No data	NA	NA	Suppression only. Preventative only. Not for use in California.	0	4	None.	Moderate eye irritation. May cause dermal sensitization. [F]	None.	None.

Comparative Overview of Efficacy, Hazards, and Use Restrictions
Crop Group 13: Berries and Small Fruits: Strawberries / Powdery Mildew (*Podosphaera aphanis*, *Sphacelotheca* sp.)

NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Non-synthetic	NC; Bio-chemical	Rhamnolipid biosurfactant	Zonix	72431-1	No data	NA	NA	Powdery mildew control claim. Mix-and-match directions for use. [E] No specific crop/disease claims. Preventative use only.	0	4	None.	Irreversible eye damage.	None.	Do not use at ambient temperatures over 80°F. Keep from overheating or freezing. Store out of direct sunlight.
Non-synthetic	NC; Biological	*Streptomyces lydicus* WYEC	Actinovate	73314-1	No data	NA	NA	Powdery mildew claim. Mix-and-match directions for use. [E] No specific crop/disease claims. Field uses: Control vs suppression only is not specified. Greenhouse uses: Suppression only.	0	1 or until dry	None.	Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Live bacterium. Use and storage temperature restrictions.
Non-synthetic	NC; Botanical oil	Neem oil	Trilogy	70051-2	No data	NA	NA	Powdery mildew control. Mix-and-match directions for use. [E] No specific crop/disease claims.	0	4	Yes.	Moderate eye irritation.	Toxic to fish, aquatic organisms, and bees.	Temperature restrictions. Storage restrictions.
Non-synthetic	NC; Botanical oil	Cinnamon oil	Cinnerate	NA; 25(b)	No data	NA	NA	Control.	0	0	None.	Eye and skin irritation. May cause dermal sensitization. [F]	None.	Do not expose to light.
Non-synthetic	NC; Botanical oil	Garlic oil, Cottonseed oil, Corn oil	Mildew Cure	NA; 25(b)	No data	NA	NA	General powdery mildew claim; not crop specific.	0	0	None.	Avoid contact with skin, eyes, and clothing.	No FIFRA statement.	None.
Non-synthetic	NC; Botanical oil	Clove oil, Rosemary oil, Peppermint oil	BacStop	NA; 25(b)	No data	NA	NA	Control.	0	0	None.	Temporary eye and skin irritation	No FIFRA statements.	Storage temperature restrictions.
Non-synthetic	NC; Botanical oil	Rosemary oil, Clove oil, Thyme oil	Sporatec	NA; 25(b)	No data	NA	NA	Control.	0	0	Yes.	Harmful if swallowed.	Toxic to bees.	Not for use near heat or open flames.
Non-synthetic	NC; Botanical oil	Soybean oil	Golden Pest Spray	57538-11	No data	NA	NA	Control.	0	4	Yes.	Harmful if swallowed, absorbed through skin, or inhaled. Moderate eye irritation	None.	Temperature restrictions on use.

Comparative Overview of Efficacy, Hazards, and Use Restrictions
Crop Group 13: Berries and Small Fruits: Strawberries / Powdery Mildew (*Podosphaera aphanis*, *Sphacelotheca* sp.)

NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Synthetic	M1	Copper octanoate	Cueva	67702-2-70051	No data	NA	NA	Control.	0	4	Yes.	Harmful if swallowed or absorbed through skin.	Toxic to fish and aquatic organisms.	Do not store below 4°C (39°F). Tank-mix restrictions.
Synthetic	M2	Sulfur	Acoidal	62562-4	No data	NA	NA	Control.	0	24	Yes.	Harmful if swallowed, inhaled, or absorbed through skin.	Toxic to fish and aquatic organisms.	Suspended dust ignites easily.
Synthetic	M2	Sulfur	Cosavet-DF	70905-1	No data	NA	NA	Control.	0	24	Yes.	Harmful if swallowed, inhaled, or absorbed through skin. Moderate eye irritation.	None.	Suspended dust ignites easily.
Synthetic	M2	Sulfur	Defend DF	62562-8	No data	NA	NA	Control.	0	24	Yes.	Harmful if swallowed, inhaled, or absorbed through skin.	Toxic to fish and aquatic organisms.	Suspended dust ignites easily.
Synthetic	M2	Sulfur	Kumulus DF	51306-352-66330	No data	NA	NA	Control.	0	24	Yes.	Harmful if swallowed. Avoid contact with eyes, skin, and clothing.	None.	Do not store above 104°F.
Synthetic	M2	Sulfur	Micro Sulf	55146-75	No data	NA	NA	Control.	0	24	Yes.	Harmful if swallowed, inhaled, or absorbed through skin. Eye irritation.	None.	Keep away from heat, sparks, or flames.
Synthetic	M2	Sulfur	Microthiol Disperss	70506-187	64	4	3:SMF016; 2:SMF042; F&N 61:SMF009; F&N 60:SMF006.	Control.	0	24	Yes.	Harmful if swallowed, inhaled, or absorbed through skin.	None.	Do not store near flammable materials.
Synthetic	M2	Sulfur	Thiolux	34704-1079	No data	NA	NA	Control.	0	24	Yes.	Harmful if swallowed, inhaled, or absorbed through skin. Eye irritation.	None.	Suspended dust ignites easily.
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Agricure	70870-1	No data	NA	NA	Powdery mildew control claim. Mix-and-match directions for use. [E] No specific crop/disease claims.	0	1	None.	Harmful if swallowed. Moderate eye irritation.	None.	Mild alkaline solution; tank-mix restrictions.
Synthetic	NC; Inorganic salt	Potassium bicarbonate	EcoMate Armicarb O	5905-541	No data	NA	NA	Control.	0	4	None.	Harmful if swallowed. Moderate eye irritation.	None.	Avoid contamination by pesticides and fertilizers. Final spray solution pH must be ≥7.0.
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Kaligreen	70231-1	23	1	F&N 56:SMF47	General powdery mildew control claim.	1	4	None.	Harmful if swallowed.	None.	Chemical incompatibilities.

Comparative Overview of Efficacy, Hazards, and Use Restrictions
Crop Group 13: Berries and Small Fruits: Strawberries / Powdery Mildew (*Podosphaera aphanis*, *Sphacelotheca* sp.)

NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Milstop	70871-1-68539	No data	NA	NA	Powdery mildew control claim. Mix-and-match directions for use. [E] No specific crop/disease claims.	1	4	None.	Harmful if swallowed. Moderate eye irritation	None.	Chemical incompatibilities.
Synthetic	NC; Inorganic salt	Potassium silicate	Sil-Matrix	82100-1	No data	NA	NA	General powdery mildew control claim. Preventative only.	0	4	None.	Moderate eye irritation.	None.	Chemical incompatibilities.
Synthetic	NC; Organic salt	Potassium salts of fatty acids	M-Pede	10163-324	No data	NA	NA	Control.	0	12	Yes.	Substantial eye injury. Skin irritation.	Harmful to aquatic invertebrates	If water has high mineral content, check for compatibility.
Synthetic	NC; Organic salt	Insecticidal soap	Des-X	67702-22-70051	No data	NA	NA	Control.	0	12	Yes.	Substantial eye injury. Skin irritation.	Harmful to aquatic invertebrates	If water has high mineral content, check for compatibility.
Synthetic	NC; Oxidizing agent	Hydrogen dioxide, Peroxyacetic acid	Oxidate	70299-2	10	1	2:SMF042	Control.	0	Until dry	None.	Irreversible eye damage. May be fatal if swallowed. Skin irritation.	Highly toxic to bees and other beneficial insects. Toxic to fish.	Chemical instabilities. Strong oxidizing agent. Use and storage temperature restrictions.
Synthetic	NC; Oxidizing agent	Hydrogen peroxide, Hydrogen dioxide	Perpose Plus	86729-1	No data	NA	NA	Powdery mildew control claim for all agricultural crops. Preventative only.	0	Until dry	None.	Irreversible eye damage and skin burns. May be fatal if absorbed through skin. Harmful if swallowed.	Toxic to birds, mammals, fish, and aquatic life.	Chemical instabilities. Strong oxidizing agent. Storage restrictions.
Synthetic	NC; Petroleum oil	Mineral oil	Glacial Spray Liquid	34704-849	No data	NA	NA	Control.	0	4	Yes (with sulfur).	Harmful if swallowed, inhaled, or absorbed through skin. Eye irritation. May cause dermal sensitization. [F]	Hazardous to aquatic organisms.	None.
Synthetic	NC; Petroleum oil	Mineral oil	JMS Stylet Oil	65564-1	No data	NA	NA	Control.	0	4	Yes (with sulfur).	Harmful if swallowed.	Toxic to fish.	None.
Synthetic	NC; Petroleum oil	Mineral oil	Omni Supreme Spray	5905-368	No data	NA	NA	Control.	0	12	Yes (with sulfur).	Harmful if absorbed through skin. May cause dermal sensitization. [F]	Toxic to fish and aquatic organisms.	Chemical incompatibilities.
Synthetic	NC; Petroleum oil	Mineral oil	PureSpray Green	69526-9	No data	NA	NA	Control.	0	4	Yes (with sulfur).	Harmful if swallowed or absorbed through skin. May cause dermal sensitization. [F]	Toxic to aquatic organisms.	None.

Comparative Overview of Efficacy, Hazards, and Use Restrictions
Crop Group 13: Berries and Small Fruits: Strawberries / Powdery Mildew (*Podosphaera aphanis*, *Sphacelotheca* sp.)

NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Synthetic	NC; Petroleum oil	Mineral oil	SuffOil-X	48813-1-68539	No data	NA	NA	Control.	0	4	Yes (with sulfur).	Harmful if swallowed. May cause dermal sensitization. [F]	Toxic to aquatic organisms.	None.
Synthetic	NC; Petroleum oil	Mineral oil	TriTek	48813-1	No data	NA	NA	Control.	0	4	Yes (with sulfur).	Harmful if swallowed or absorbed through skin. May cause dermal sensitization. [F]	Toxic to aquatic organisms.	None.

A. FRAC = Fungicide Resistance Action Committee. Products with the same mode of action have the same FRAC Code. NC = Not classified; no FRAC code has been assigned.
B. For Polyoxin D zinc salt (Oso), from summarizes trials, published and unpublished. For OMRI-listed alternatives, from Plant Disease Management Reports (PDMR).
C. Number of trials included in the calculation of the mean.
D. PDMR = Plant Disease Management Reports (on-line journal generally used for publication of efficacy research conducted at universities). Preceded by F&N = Fungicides and Nematicides. https://www.plantmanagementnetwork.org/pub/trial/pdmr/
E. Mix-and-match directions for use. Label has a list of crops and a separate list of diseases with no claim for specific crop/disease combinations.
F. Complete label statement: Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals.
G. EPA relative environmental toxicity descriptors, lowest toxicity to highest toxicity: Practically non-toxic < Moderately toxic < Toxic < Highly toxic.

Plant Disease Management Reports citations and data summaries:

3:SMF016. J. Mertely, T. Seijo, *et al.*, University of Florida. Evaluation of fungicides to control powdery mildew on annual strawberry, 2007-08.
Serenade Max at 1 lb/A: No control of powdery mildew on fruit (more disease than in the untreated control). No control and 5% control of powdery mildew on leaves. Mean control: 2% (n = 3.
Microthiol Disperss 80 WP at 7.5 lb/A: 81% and 95% control of powdery mildew on fruit. 26%, 30%, 33%, and 60% control of powdery mildew on leaves. Mean control: 54% (n = 6).

2:SMF042. J. Mertely, T. Seijo, *et al.*, University of Florida. Evaluation of fungicides to control powdery mildew on annual strawberry, 2006-07.
Microthiol Disperss 80WP at 7.5 lb/A: 71% control of powdery mildew on fruit.
Oxidate at 84 fl oz/A: 10% control of powdery mildew on fruit.

F&N 61:SMF009. J. Mertely, T. Seijo, *et al.*, University of Florida. Evaluation of fungicides to control powdery mildew on annual strawberry, 2004-05.
Microthiol Disperss 80 WP at 7.5 lb/A: 12% control of powdery mildew on foliage. 71% control of powdery mildew on fruit. Mean control: 41% (n = 5).

F&N 60:SMF006. J. Mertely, T. Seijo, and N. A. Peres, University of Florida. Evaluation of fungicides to control powdery mildew on annual strawberry, 2003-04.
Microthiol Disperss 80 WP at 7.5 lb/A: 90% control of powdery mildew incidence on fruit.

F&N 56:SMF47. D. E. Legard, C. L. Xiao, et al., University of Florida. Evaluation of fungicides to control powdery mildew of strawberry, 2000
Kaligreen 82WP at 3 lb/A at 7-day intervals: 23% control of powdery mildew.

OMRI-LISTED ALTERNATIVES: CROP GROUP 19: HERBS AND SPICES: BASIL / Downy Mildew (*Peronospora belbahrii*)

Comparative Overview of Efficacy, Hazards, and Use Restrictions Crop Group 19: Herbs and Spices : Basil / Downy Mildew (*Peronospora belbahrii*)														
NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Synthetic	19	Polyoxin D zinc salt	Oso	68173-4	52	1	See Oso efficacy summary table.	Control.	0	4	None.	May cause dermal sensitization. [F]	Moderately toxic to fish and aquatic invertebrates.	None.
Non-synthetic	44	*Bacillus amylo-liquefaciens* strain D747	Double Nickel 55	70051-108	40	1	11:V030	Suppression only. Preventative only.	0	4	None.	Moderate eye irritation. May cause dermal sensitization. [F]	None.	Water pH restrictions.
Non-synthetic	44	*Bacillus amylo-liquefaciens* strain D747	Double Nickel LC	70051-114	No data	NA	NA	Suppression only. Preventative only.	0	4	None.	Moderate eye irritation. May cause dermal sensitization. [F]	None.	Water pH restrictions.
Non-synthetic	P5	*Reynoutria sachalinensis* extract	Regalia	84059-3	14	6	9:V001; 7:V015; 6:V059; 6:V099; 5:V098; 5:V155.	Control. Preventative only.	0	4	None.	Moderate eye irritation.	None.	Avoid freezing.
Non-synthetic	NC; Biological	*Streptomyces lydicus* WYEC	Actinovate	73314-1	No data	NA	NA	Downy mildew claim. Mix-and-match directions for use. [E] No specific crop/disease claims. Field uses: Control vs suppression only is not specified. Greenhouse uses: Suppression only.	0	1 or until dry	None.	Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Live bacterium. Use and storage temperature restrictions.
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Agricure	70870-1	No data	NA	NA	Downy mildew control claim. Mix-and-match directions for use. [E] No specific crop/disease claims. Not for use in California.	0	1	None.	Harmful if swallowed. Moderate eye irritation.	None.	Mild alkaline solution; tank-mix restrictions.

Comparative Overview of Efficacy, Hazards, and Use Restrictions Crop Group 19: Herbs and Spices : Basil / Downy Mildew (*Peronospora belbahrii*)														
NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Milstop	70870-1-68539	13	2	7:V045; 6:V073.	Downy mildew control claim. Mix-and-match directions for use. [E] No specific crop/disease claims. Not for use in California.	0	1	None.	Harmful if swallowed. Moderate eye irritation.	None.	Mild alkaline solution; tank-mix restrictions.
Synthetic	NC; Oxidizing agent	Hydrogen dioxide, Peroxyacetic acid	Oxidate	70299-2	20	1	6:V073	Control.	0	Until dry	None.	Irreversible eye damage. May be fatal if swallowed. Skin irritation.	Highly toxic to bees and other beneficial insects. Toxic to fish.	Chemical instabilities. Strong oxidizing agent. Use and storage temperature restrictions.

A. FRAC = Fungicide Resistance Action Committee. Products with the same mode of action have the same FRAC Code. NC = Not classified; no FRAC code has been assigned.
B. For Polyoxin D zinc salt (Oso), from summarizes trials, published and unpublished. For OMRI-listed alternatives, from Plant Disease Management Reports (PDMR).
C. Number of trials included in the calculation of the mean.
D. PDMR = Plant Disease Management Reports (on-line journal generally used for publication of efficacy research conducted at universities). Preceded by F&N = Fungicides and Nematicides. https://www.plantmanagementnetwork.org/pub/trial/pdmr/
E. Mix-and-match directions for use. Label has a list of crops and a separate list of diseases with no claim for specific crop/disease combinations.
F. Complete label statement: Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals.
G. EPA relative environmental toxicity descriptors, lowest toxicity to highest toxicity: Practically non-toxic < Moderately toxic < Toxic < Highly toxic.

Comparative Overview of Efficacy, Hazards, and Use Restrictions Crop Group 19: Herbs and Spices : Basil / Downy Mildew (*Peronospora belbahrii*)													
NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Plant Disease Management Reports Citations and data summaries for non-synthetic alternatives: 11:V030. M. T. McGrath and Z. F. Sexton, Cornell University. Evaluation of biopesticides and an organic copper fungicide for downy mildew in sweet basil, 2016. Double Nickel 55 at 3 lb/acre, August 2, 2016: 41.9%, 25.9%, and 52.8% control of incidence. Trial mean: 40.2% control (n = 3). 9:V001. S. B. Scheufel et al., Univ. of Massachusetts. Evaluation of copper fungicides for management of basil downy mildew in organic systems, 2014. Regalia at 4 qt/A: 0.8% control of downy mildew on basil. 7:V015. M.T. McGrath and K. A Lamarsh, Cornell University. Evaluation of fungicides for managing downy mildew in basil, 2012. Regalia at 0.5%: 15.6% control of downy mildew on basil leaves. 6:V059. Z. Mercha et al., Univ. Of Florida, Evaluation of biologicals and biorationals for control of basil downy mildew under greenhouse conditions, 2010. Regalia SC at 1%: 10.3% and 26.0% control of downy mildew severity on basil leaves in two different experiments. Trial mean: 18% control (n = 2). 6:V099. M.T. McGrath and L.K. Hunsberger, Cornell University. Evaluation of biopesticides for managing downy mildew in basil, 2011. Regalia (1%): 28.4% control of downy mildew incidence on basil. 5:V098. M.T. McGrath and L.K. Nunsberger, Cornell University. Evaluation of biopesticides for managing downy mildew in basil, 2010. Regalia (1% v/v): No control of downy mildew on basil. Disease severity exceeded that in the untreated control. 5:V155. R. N. Raid, University of Florida. Evaluation of Regalia, alone and in tank-mixture, for control of basil downy mildew, Fall 2010. Regalia (1% v/v)/A: 23% control of downy mildew severity.													
Plant Disease Management Reports Citations and data summaries for synthetic alternatives: 7:V045. J.E. Allen and M. Saska, University of Connecticut. Basil downy mildew control using organic fungicides and nitrogen fertilization rate, 2012. Milstop at 2.5 lb/A, 5 or 6 application beginning August 2 or 3, 2012: 0% to 2% control of downy mildew on basil. Trial mean: 1% control (n = 2). 6:V073. J.E. Allen and A. Patrie, University of Connecticut. Evaluation of organic control products for basil downy mildew, 2011. Milstop at 2.5 lb/A, 5 applications: 16.8% and 33.8% control of downy mildew on basil. Trial mean: 25.3% control (n = 2). Oxidate at 0.6 gal/A with Yucca Ag-Aide at 0.125% (v/v)/A: 13.9% and 25.8% control of down mildew on basil. Trial mean: 19.9% control (n = 2).													

STEP 3: Identification of Relative Efficacy for Non-Synthetic and Synthetic OMRI-Listed Alternative Products

METHODOLOGY

The tables from Step 2 were reviewed to separately quantify for non-synthetic and synthetic OMRI-listed alternative products the number of OMRI-listed products for each crop/disease combination having:

- Mean efficacy comparable to greater than the polyoxin D zinc salt 5SC formulation (a.k.a. Oso);
- Mean efficacy less than comparable to Oso but more than 50% to mean efficacy of Oso;
- Mean efficacy less than 50% of the mean efficacy of Oso; and
- No efficacy data published in Plant Disease Management Reports (going back to 2000).

Products with mean efficacy comparable or greater than the polyoxin D zinc salt 5SC formulation were identified for further consideration.

Overview of Efficacy Comparisons of Oso to OMRI-Listed Alternatives

Disease (Pathogen)	EPA Registered, OMRI-Listed Alternative Products											
	Non-Synthetic						Synthetic					
	FRAC Codes (Modes of Action) or Non-Classified AI Type		Number of Alternative Products				FRAC Codes (Modes of Action) or Non-Classified AI Type		Number of Alternative Products			
	Total	FRAC Code [A]	Mean Efficacy Comparable to or Greater than Oso	Mean Efficacy Less than Comparable to Oso to 50% Oso	Mean Efficacy Less than 50% Oso	No Efficacy Data	Total	FRAC Code [A]	Mean Efficacy Comparable to or Greater than Oso	Mean Efficacy Less than Comparable to Oso to 50% Oso	Mean Efficacy Less than 50% Oso	No Efficacy Data
Crop Group 13: Blueberries												
Alternaria fruit rot (*Alternaria* spp.)	4	44 (*Bacillus*); P5 (Regalia); Biological; Botanical oil.	0	0	0	9	1	Oxidizing agent.	0	0	0	1
Botrytis blight (*Botrytis cinerea*)	4	44 (*Bacillus*); P5 (Regalia); Biological; Botanical oil.	0	1	2	11	2	Inorganic salt; Oxidizing agent.	0	0	0	6
Mummyberry (*Monilinia vaccinii-corymbosi*)	4	44 (*Bacillus*); P5 (Regalia); Biological; Botanical oil.	1 (Optiva)	2	3	5	2	Inorganic salt; Oxidizing agent.	0	0	0	2

Overview of Efficacy Comparisons of Oso to OMRI-Listed Alternatives

Disease (Pathogen)	EPA Registered, OMRI-Listed Alternative Products											
	Non-Synthetic						Synthetic					
	FRAC Codes (Modes of Action) or Non-Classified AI Type		Number of Alternative Products				FRAC Codes (Modes of Action) or Non-Classified AI Type		Number of Alternative Products			
	Total	FRAC Code [A]	Mean Efficacy Comparable to or Greater than Oso	Mean Efficacy Less than Comparable to Oso to 50% Oso	Mean Efficacy Less than 50% Oso	No Efficacy Data	Total	FRAC Code [A]	Mean Efficacy Comparable to or Greater than Oso	Mean Efficacy Less than Comparable to Oso to 50% Oso	Mean Efficacy Less than 50% Oso	No Efficacy Data
Crop Group 13: Caneberries												
Botrytis fruit rot (*Botrytis cinerea*)	5	44 (*Bacillus*); P5 (Regalia); Biochemical; Biological; Botanical oil.	0	1	3	8	3	M1 (copper); Inorganic salt; Oxidizing agent.	0	0	1	4
Powdery mildew (*Podosphaera aphanais*)	6	44 (*Bacillus*); P5 (Regalia); Biochemical; Biological; Botanical oil; Organic acid.	0	0	0	11	5	M2 (sulfur); Inorganic salt; Organic salt; Oxidizing agent; Petroleum oil.	0	0	0	22
Crop Group 13: Cranberries												
Cottonball (*Monilinia oxycocci*)	0	No applicable.	0	0	0	0	0	No applicable.	0	0	0	0
Fruit rot complex (*Coleophoma empetri*, *Colletotrichum acutatum*, *Colletotrichum gloeosporioides*, *Phyllosticta vaccinii*, and *Physalospora vaccinii*, etc.)	0	No applicable.	0	0	0	0	1	M1 (copper).	0	0	1	5

Overview of Efficacy Comparisons of Oso to OMRI-Listed Alternatives

Disease (Pathogen)	EPA Registered, OMRI-Listed Alternative Products											
	Non-Synthetic						Synthetic					
	FRAC Codes (Modes of Action) or Non-Classified AI Type		Number of Alternative Products				FRAC Codes (Modes of Action) or Non-Classified AI Type		Number of Alternative Products			
	Total	FRAC Code [A]	Mean Efficacy Comparable to or Greater than Oso	Mean Efficacy Less than Comparable to Oso to 50% Oso	Mean Efficacy Less than 50% Oso	No Efficacy Data	Total	FRAC Code [A]	Mean Efficacy Comparable to or Greater than Oso	Mean Efficacy Less than Comparable to Oso to 50% Oso	Mean Efficacy Less than 50% Oso	No Efficacy Data
Crop Group 13: Grapes												
Black rot (*Guignardia bidwellii*)	3	44 (*Bacillus*); P5 (Regalia); Botanical oil	0	0	1	3	1	M1(copper).	2 (Badge X2, Nu-Cop 50 WP)	1	1	6
Bunch rot (*Botrytis cinerea*)	4	44 (*Bacillus*); P5 (Regalia); Biological; Botanical oil	2 (Double Nickel 55 and LC)	2	3	9	3	Inorganic salt; Oxidizing agent; Petroleum oil.	0	0	3	6
Downy mildew (*Plasmopara viticola*)	4	44 (*Bacillus*); P5 (Regalia); Biological; Botanical oil	0	1	1	10	3	M1 (copper); Inorganic salt; Oxidizing agent.	3 (Badge X2, Cueva, Oxidate)	0	0	13
Phomopsis fruit rot (*Phomopsis viticola*)	3	44 (*Bacillus*); P5 (Regalia); Botanical oil	0	0	0	10	3	M1 (copper); M2 (sulfur); Inorganic salt	0	0	1	13
Powdery mildew (*Erisyphe necator*)	5	44 (*Bacillus*); P5 (Regalia); Biological; Botanical oil; Organic acid.	0	0	4	14	6	M1 (copper); M2 (sulfur); Inorganic salt; Organic salt; Oxidizing agent; Petroleum oil.	1 (Micro Sulf)	3	2	24

Overview of Efficacy Comparisons of Oso to OMRI-Listed Alternatives

Disease (Pathogen)	EPA Registered, OMRI-Listed Alternative Products											
	Non-Synthetic						Synthetic					
	FRAC Codes (Modes of Action) or Non-Classified AI Type		Number of Alternative Products				FRAC Codes (Modes of Action) or Non-Classified AI Type		Number of Alternative Products			
	Total	FRAC Code [A]	Mean Efficacy Comparable to or Greater than Oso	Mean Efficacy Less than Comparable to Oso to 50% Oso	Mean Efficacy Less than 50% Oso	No Efficacy Data	Total	FRAC Code [A]	Mean Efficacy Comparable to or Greater than Oso	Mean Efficacy Less than Comparable to Oso to 50% Oso	Mean Efficacy Less than 50% Oso	No Efficacy Data
Crop Group 13: Strawberries												
Anthracnose fruit rot (*Colletotrichum acutatum*)	4	44 (*Bacillus*); P5 (Regalia); Biological; Botanical oil.	0	0	1	9	3	M1 (copper); Inorganic salt; Oxidizing agent.	0	0	0	5
Gray mold (*Botrytis cinerea*)	5	44 (*Bacillus*); P5 (Regalia); Biochemical; Biological; Botanical oil.	0	0	7	11	4	M1 (copper); Inorganic salt; Oxidizing agent; Petroleum oil.	0	0	2	6
Leather rot (*Phytophthora cactorum*)	2	BM2; Biological.	0	0	0	5	0	No applicable.	0	0	0	0
Phomopsis leaf spot (blight) (*Phomopsis obscurans*)	2	P5 (Regalia); Biological.	0	1	0	1	2	M1 (copper); Inorganic salt.	1 (Cueva)	0	0	3
Phomopsis fruit rot (Soft rot) (*Phomopsis obscurans*)	1	Biological.	0	0	0	1	1	Inorganic salt.	0	0	0	2
Powdery mildew (*Podosphaera aphanis*)	4	44 (*Bacillus*); Biochemical; Biological; Botanical oil.	0	0	1	14	6	M1 (copper); M2 (sulfur); Inorganic salt; Organic salt; Oxidizing agent; Petroleum oil.	1 (Microthiol Disperss)	1	1	20
Crop Group 19: Basil												
Downy mildew (*Peronospora belbahrii*)	3	44 (*Bacillus*); P5 (Regalia); Biological	0	1	1	2	2	Inorganic salt; Oxidizing agent.	0	0	2	1

A. Examples of active ingredients with listed FRAC Code or not classified active ingredient types:

- Biochemical: *Rhamnolipdi* biosurfactant (Zonix).
- Biological: *Aureobasidium pullulans* (Botector), *Gliocladium catenulatum* (Prestop) *Streptomyces lydicus* (Actinovate), and *Ulacladium ouderansii* (Zen-O-Spore).
- Botanical oil: Cinnamon oil, Clove oil, Corn oil, Cotton seed oil, Garlic oil, Neem oil, Rosemary oil, and Thyme oil.
- BM2: *Trichoderma* spp. (Bio-Tam and Rootshield).
- Inorganic salt: Potassium bicarbonate and Potassium silicate.
- Organic acid: Citric acid.
- Organic salt: Insecticidal soap and Potassium salts of fatty acids.
- Oxidizing agent: Hydrogen dioxide, Hydrogen peroxide, and Peroxyacetic acid.
- Petroleum oil: Aliphatic petroleum solvent and Mineral oil.

CONCLUSIONS: Based upon *disease economic significant and efficacy data alone*, there is organic grower need for the polyoxin D zinc salt 5SC formulation for treatment of:

- **Blueberries for control of:**
  - **Alternaria blight (*Alternaria* spp.); and**
  - **Botrytis blight (*Botrytis cinerea*);**
- **Caneberries for control of:**
  - **Botrytis fruit rot (*Botrytis cinerea*); and**
  - **Powdery mildew (*Podosphaera aphanais*);**
- **Cranberries for control of:**
  - **Cottonball (Monilinia oxycocci); and**
  - **Fruit rot complex (*Coleophoma empetri*, *Colletotrichum acutatum*, *Colletotrichum gloeosporioides*, *Phyllosticta vaccinii*, and *Physalospora vaccinii*, etc.);**
- **Grapes for control of:**
  - **Phomopsis fruit rot (*Phomopsis viticola*);**
- **Strawberries for control of:**
  - **Anthracnose fruit rot (*Colletotrichum acutatum*);**
  - **Gray mold (*Botrytis cinerea*);**
  - **Leather rot (*Phytophthora cactorum*); and**
  - **Phomopsis fruit rot (soft rot) (*Phomopsis obscurans*); and**
- **Basil for control of:**
  - **Downy mildew (*Peronospora belbahrii*).**

Please note:

- For scheduling reasons, this analysis is limited to berries and small fruits and basil. Similar results are anticipated if other crop/disease combinations were analyzed.
- There is no EPA registered, OMRI-listed alternative for treatment of cranberries for control of cottonball (*Monilinia oxycocci*).

STEP 4: Further Consideration of OMRI-listed Products with Comparable or Greater Mean Efficacy Compared to the Polyoxin D Zinc Salt 5SC Formulation

METHODOLOGY

Step 3 summarizes disease/crop combinations for which one or more OMRI-listed products has comparable for superior efficacy based upon he mean of trial means. These OMRI-listed alternatives were noted in Step 2 using a *green background* to indicate comparable or superior mean trial efficacy.

For each crop/disease combination with an OMRI-listed identified in Step 2 and Step 3 as comparable or superior to that of the polyoxin D zinc salt 5SC formulation:

- The relevant table from Step 2 was copied and reduced in scope to focus on OMRI-listed alternative products with comparable or greater than that for the polyoxin D zinc salt.
  - Rows with efficacy information highlighted with a green background were retained.
  - All other rows for OMRI-listed alternatives (less than comparable efficacy or no data) were deleted.
  - Summaries of the data published in PDMR for the subject OMRI-listed alternatives were retained. Others were deleted.
- Table 1 was copied and reduced in scope to focus on crop/disease combinations with one or more OMRI-listed alternative products with comparable or greater than that for the polyoxin D zinc salt 5SC formulation.
  - Rows for the crop/disease combination under consideration were retained.
  - Rows for other crop/disease combinations were deleted.

The reduced scope tables from Step 2 and Step 1 are provided below.

Step 4 examined and provided commentary on:

- The *individual* efficacy trial results for the trials in the reduced scope Step 1 tables; and
- Phytotoxicity, human hazards, and environmental hazards label statements summarized in the reduced scope Step 2 tables.

BLUEBERRIES / Mummyberry (*Monilinia vaccinii-corymbosi*)

Please see the tables below.

From Step 2:
Comparative Overview of Efficacy, Hazards, and Use Restrictions
Crop Group 13: Berries and Small Fruits: Blueberries / Mummyberry (*Monilinia vaccinii-corymbosi*)

NOP Status	FRAC [A] Code(s)	Active Ingredient (s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Synthetic	19	Polyoxin D zinc salt	Oso	68173-4	64	6	See Oso efficacy summary table.	Control.	0	4	None	May cause dermal sensitization. [F]	Moderately toxic to fish and aquatic invertebrates.	None.
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Optiva	264-1160	78	1	7:SMF013.	Suppression only. Preventative only.	0	4	None	Moderate eye irritation. May cause dermal sensitization. [F]	None.	None.

A. FRAC = Fungicide Resistance Action Committee. Products with the same mode of action have the same FRAC Code. NC = Not classified; no FRAC code has been assigned.
B. For Polyoxin D zinc salt (Oso), from summarizes trials, published and unpublished. For OMRI-listed alternatives, from Plant Disease Management Reports (PDMR).
C. Number of trials included in the calculation of the mean.
D. PDMR = Plant Disease Management Reports (on-line journal generally used for publication of efficacy research conducted at universities). Preceded by F&N = Fungicides and Nematicides. https://www.plantmanagementnetwork.org/pub/trial/pdmr/
E. Mix-and-match directions for use. Label has a list of crops and a separate list of diseases with no claim for specific crop/disease combinations.
F. Complete label statement: Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals.
G. EPA relative toxicity descriptors, lowest toxicity to highest toxicity: Practically nontoxic < Moderately toxic < Toxic < Highly toxic.

Plant Disease Management Reports citations and data summaries:

7:SMF013. A.M.C. Schilder, J. M. Gillett, and W. Sysaks, Michigan State University. Evaluating fungicides and biocontrol products for control of mummyberry in blueberries, 2012.
Optiva at 1 lb/A + Nu Film P at 0.25%(v/v) beginning at pink bud: 79.0% control of shoot strikes and 76.3% control of mummies. Trial mean: 77.7% control (n = 2).

From Step 1:
Cumulative Summary of the Efficacy of the Polyoxin D Zinc Salt 5SC Suspension Concentrate Fungicide (EPA Reg. No. 68173-4) and Oso 5%SC Fungicide (EPA Reg. No. 68173-4-70051) Applied as a Foliar Spray to Growing Food Crops Using Ground Application Equipment

Disease	Pathogen	Crop Tested & Sequence No.	Trial No.	State	Formulation [1]	No. App.	Application Interval (Days)	Application Rate		Mean Control (%)		Mean Yield Increase (%)	Application Type(s)	Inoculated?	Max. Pest Pressure in UTC (%)	Phyto-tox ?	Publication Status	Notes
								fl oz/ acre	g a.i./ ha	Leaves	Fruit							
CROP GROUP 13: BERRIES AND SMALL FRUITS: BLUEBERRIES																		
Mummyberry	*Monilinia vaccinii-corymbosi*	Blueberries #1	CER-2015-008	OR	Oso + Induce (wetter/ sticker; 6 fl oz/100 gal)	9	4 - 8	5.6	21.6	NA	21.3	NA	Preventative and curative	No	34.8	No	PDMR 10:SMF026	
		Blueberries #2	CER-2015-143	MI	Oso + LI 700 (penetrant, acidifier; 0.125% v/v)	5	7 - 14	6.5	25	89	94	NA	Preventative	No	46.5 mummies/ bush	No	PDMR 10:SMF009	
		Blueberries #3	KAK-2016-Blueberry-MI	MI	Oso	8	8 - 23	6.5	25	90.8	90.7	NA	Preventative and curative	No	57.8 shoot strikes/ bush	No	PDMR (Planned fall 2018 publication) (Permission)	New data.
								13	50	100	100	NA						
					Oso + LI 700 (penetrant, acidifier; 0.125% v/v)			6.5	25	87.9	88.2	NA						
		Blueberries #4	KAK-2016-Blueberry-WA-Conv	WA	Oso	6	10 - 16	6.5	25	83.0	84.3	NA	Preventative	No	17.8 Mummies/ bush	No	Permission.	New data.
								13	50	83.0	87.1							
		Blueberries #5	KAK-2016-Blueberry-WA-Org	WA	Oso	7	6 - 9	6.5	25	-64.4	17.8	NA	Preventative	No	45.0 (fruit)	No	Permission.	New data. Includes Oso with microbial pesticides.
								13	50	32.5	30.0	NA						
		Blueberries #6	KAK-2017-Blueberry-WA-Org	WA	Oso	7	5 - 11	6.5	25	NA	63	NA	Preventative	No	6.3	No	Permission.	New data. Includes Oso with microbial pesticides.
								13	50	NA	68	NA						
							Mean Conven-tional	5.6 - 6.5	21.6 - 25	88	77	NA						
								13	20	91.5	93.6	NA						
							Mean Organic	6.5	25	-64.4	40	NA						
								13	50	32.5	49	NA						

1. "Veggieturbo 5SC Suspension Concentrate Fungicide" is Kaken's EPA registered brand name for Polyoxin D Zinc Salt 5SC Fungicide.
"Oso 5%SC Fungicide" and "Tavano 5%SC Fungicide" are Certis USA, L.L.C. supplemental distributor brand names for Polyoxin D Zinc Salt 5SC Fungicide.
"CX-10440" is the Certis USA, L.L.C. formulation code for Polyoxin D Zinc Salt 5SC Fungicide.

NR. Not reported.

Preventative and curative: Treatments include at least one application after disease was observed.
Curative: Disease was confirmed to be present before the first treatment was applied.

Comparison with Optiva (Non-Synthetic)
A *single trial* with Optiva demonstrated 78% control of blueberry/mummyberry.

Six trials with Oso provided a mean of 64% control of blueberry/mummyberry. This 64% control value includes:

- One trial (CER-2015-008) which was conducted at a rate that was *below* the minimum application rate permitted by the label; and
- Two trials (KAK-2016-Blueberry-WA-Org and KAK-2017-Blueberry-WA-Org) for which the other treatments were organic products that provided inferior disease control. It is believed that the poor control of the nearby organic product sub-plots facilitated re-infection of the Oso treated sub-plot and reduced the control observed in the Oso sub-plot.

Please note that three trials (CER-2015-143, KAK-2016-Blueberry-MI, and KAK-2016-Blueberry-WA-Conv) provided 91.5%, 92.9% and 84.4% mean control of blueberry/mummyberry, respectively. The currently available data do not include a side-by-side comparison of Oso and Optiva. However, Kaken is optimistic that a side-by-side trial would demonstrate superior control of blueberry/mummyberry by Oso compared to Optiva.

Kaken also notes that the label for Optiva specifies that the product needs to be used *preventatively*, *i.e.*, before disease is present. The Oso labels does not have this restriction. Furthermore, 100% control of blueberry/mummyberry was observed in Trial No. KAK-2016-Blueberry-MI which included *curative* applications, *i.e.*, Oso was applied *after* disease was observed in the untreated control.

CONCLUSION: The polyoxin D zinc salt 5SC formulation offers organic blueberry growers:

- **Competitive efficacy for control of mummyberry;**
- **A treatment option *after* mummyberry is first observed;**
- **Competitive worker and environmental safety;**
- **A reduced risk product with a new non-toxic mode of action for use in resistance management and integrated pest management (IPM); and**
- **Opportunities for export of the treated crop to Canada, Mexico, New Zealand, South Korea, Taiwan, and a growing list of additional countries.**

GRAPES / Black Rot (*Guignardia bidwellii*)

Please see the tables below.

From Step 2:
Comparative Overview of Efficacy, Hazards, and Use Restrictions
Crop Group 13: Berries and Small Fruits: Grapes / Black Rot (*Guignardia bidwellii*)

NOP Status	FRAC [A] Code(s)	Active Ingredient (s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Synthetic	19	Polyoxin D zinc salt	Oso	68173-4	54	4	See Oso efficacy summary table.	Suppression.	0	4	None	May cause dermal sensitization. [F]	Moderately toxic to fish and aquatic invertebrates.	None.
Synthetic	M1	Copper oxychloride, Copper hydroxide	Badge X2	50289-12	54	2	8:SMF014; 6:SMF008.	Control.	0	48	Yes	May be fatal if swallowed. Substantial eye injury.	Toxic to fish and aquatic organisms.	May damage aluminum.
Synthetic	M1	Copper hydroxide	Nu-Cop 50 WP	42002-7	78	2	6:SMF008.	Control.	0	24	Yes	Irreversible eye damage. Harmful if swallowed, absorbed through skin, or inhaled. May cause dermal sensitization. [F]	Toxic to fish and aquatic organisms.	Damages aluminum.

A. FRAC = Fungicide Resistance Action Committee. Products with the same mode of action have the same FRAC Code. NC = Not classified; no FRAC code has been assigned.
B. For Polyoxin D zinc salt (Oso), from summarizes trials, published and unpublished. For OMRI-listed alternatives, from Plant Disease Management Reports (PDMR).
C. Number of trials included in the calculation of the mean.
D. PDMR = Plant Disease Management Reports (on-line journal generally used for publication of efficacy research conducted at universities). Preceded by F&N = Fungicides and Nematicides. https://www.plantmanagementnetwork.org/pub/trial/pdmr/
E. Mix-and-match directions for use. Label has a list of crops and a separate list of diseases with no claim for specific crop/disease combinations.
F. Complete label statement: Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals.
G. EPA relative toxicity descriptors, lowest toxicity to highest toxicity: Practically nontoxic < Moderately toxic < Toxic < Highly toxic.

Plant Disease Management Reports citations and data summaries for synthetic alternatives:

8:SMF014. Bryan Hed, Penn State University. Evaluation of organic fungicides for control of black rot and powdery and downy mildew of Concord grapes, 2013.
Badge X2 1.75 lb/A + lime 1.75 lb/A, 5 or more applications, different timings; *without* mummies: 64%, 77%, 81%, and 90% control on fruit.
Badge X2 1.75 lb/A + lime 1.75 lb/A, 5 or more applications, different timings; *with* mummies: 4%, 5%, 15%, and 22% control on fruit.
Badge X2 1.75 lb/A + lime 1.75 lb/A + Nu-Film-P, 5 or more applications, different timings; *without* mummies: 66.5%, and 71% control on fruit.
Badge X2 1.75 lb/A + lime 1.75 lb/A + Nu-Film-P, 5 or more applications, different timings; *with* mummies: 9% and 9% control on fruit.
Trial mean: 43% control (n = 12).

6:SMF008. B. Hed and N. K. Ngugi, Penn State University. Evaluation of conventional and organic fungicides for control of black rot and powdery mildew of Concord grapes, 2011.
NuCop 50 WP at 1 lb/A + Lime at 1 lb/A + Nufilm P at 0.0625%: 67% control of diseased clusters; 85% control of diseased area.
NuCop 50 WP at 2 lb/A + Lime at 2 lb/A + Nufilm P at 0.0625%: 65% control of diseased clusters; 91% control of diseased area.
NuCop 50 WP trial mean: 77% control (n = 4).
Badge X2 at 1.75 lb/A + Lime at 1.75 lb/A + Nufilm P at 0.0625%: 52% control of diseased clusters; 75% control of diseased area.
Badge X2 trial mean: 64% control (n = 2).

From Step 1:
Cumulative Summary of the Efficacy of the Polyoxin D Zinc Salt 5SC Suspension Concentrate Fungicide (EPA Reg. No. 68173-4) and Oso 5%SC Fungicide (EPA Reg. No. 68173-4-70051)
Applied as a Foliar Spray to Growing Food Crops Using Ground Application Equipment

Disease	Pathogen	Crop Tested & Sequence No.	Trial No.	State	Formulation [1]	No. App.	Application Interval (Days)	Application Rate		Mean Control (%)		Mean Yield Increase (%)	Application Type(s)	Inocu-lated?	Max. Pest Pressure in UTC (%)	Phyto-tox ?	Publication Status	Notes
								fl oz/ acre	g a.i./ ha	Leaves	Fruit							
CROP GROUP 13: BERRIES AND SMALL FRUITS: GRAPES																		
Black Rot	*Guignardia bidwellii*	Grapes #1	KAK-2016-Grape-MI	MI	Oso	7	10 - 16	6.5	25	NA	87	NA	Preventative	No	82.0	No	PDMR (Planned fall 2018 publication) (Permission)	New data.
								13	50	NA	98							
		Grapes #2	KAK-2017-Grape-MI	MI	Oso	7	11 - 20	13	50	87	86	NA	Preventative	No	66.0	No	PDMR (Planned fall 2018 publication) (Permission)	New data.
		Grapes #3	KAK-2016-Grape-PA	PA	Oso	6	9 - 12	13	50	NA	2.5	NA	Preventative	Yes	55.0	No	PDMR 11:SMF009	New data. Mummies in the trellis.
		Grapes #4	KAK-2017-Grape-PA	PA	Oso	7	9 - 11	13	50	NA	36.1	NA	Preventative	Yes	85.8	No	PDMR (Submitted)	New data. Mummies in the trellis.
							Mean	6.5	25	NA	87	NA						
								13	50	87	55.7	NA						

1. "Veggieturbo 5SC Suspension Concentrate Fungicide" is Kaken's EPA registered brand name for Polyoxin D Zinc Salt 5SC Fungicide.
"Oso 5%SC Fungicide" and "Tavano 5%SC Fungicide" are Certis USA, L.L.C. supplemental distributor brand names for Polyoxin D Zinc Salt 5SC Fungicide.
"CX-10440" is the Certis USA, L.L.C. formulation code for Polyoxin D Zinc Salt 5SC Fungicide.

NR. Not reported.

Preventative and curative: Treatments include at least one application after disease was observed.
Curative: Disease was confirmed to be present before the first treatment was applied.

Comparison with Badge X2 and Nu-Cop 50 WP (Synthetic)

Oso provided mean 54% control of grape/black rot in 4 trials. Badge X2 also provided mean 54% control on two trials, and Nu-Cop 50 WP provided mean 78% control in 2 trials.

Please note the following:

- Two trials conducted in Michigan (KAK-2016-Grape-MI and KAK-2017-Grape-MI) provided mean 93% control and 87% control of grape/black rot, respectively. *No mummies* were tied into the trellis to serve as inoculum. Naturally occurring inoculum was the source of disease. The dilution water was tap water (*not softened*).
- Two trials conducted in Pennsylvania (KAK-2016-Grape-PA and KAK-2017-Grape-PA) had disappointing results with only 2.35% control and 36.1% control, respectively. In the two Pennsylvania trials, *mummies* were tied into the trellis to serve as inoculum. The dilution water was *softened* tap water. Both the 2016 and 2017 trials were conducted during a local drought.
- Research strategies to better understand how to achieve dependable control of grape/black rot are under discussion.
- Black rot control is a high priority for organic grape growers. Many organic grape growers in Pennsylvania, New York, and nearby areas in Canada have converted back to convention production because of the high crop losses in organic vineyards due to black rot and insufficient organic black rot control options.

- Badge X2 and Nu-Cop 50 WP are the two OMRI-listed products with comparable or better control of black rot compared to Oso.
  - There are no available side-by-side trials for comparison of the efficacy with the polyoxin D zinc salt 5SC formulation.
  - Both Badge X2 and Nu-Cop 50 WP:
    - Are copper products with the same mode of action.
    - Have significantly higher hazards to humans (may be fatal is swallowed; irreversible eye damage) than the polyoxin D zinc salt 5SC formulation.
    - Have higher toxicity to fish as aquatic organisms (toxic) than the polyoxin D zinc salt 5SC formulation (moderately toxic).
- No phytotoxicity has been observed for Oso. The Badge X2 label has phytotoxicity warning statements.

CONCLUSION: The polyoxin D zinc salt 5SC formulation offers organic grape growers:

- **Competitive efficacy for control of black rot;**
- **Greater crop, worker, and environmental safety;**
- **An opportunity to reduce the amount of copper applied to their vineyards and thereby reduce the negative effects of copper on soil;**
- **Reduced (EPA's minimum) personal protective equipment requirement;**
- **Greater flexibility in growing the crop (0-day PHI instead of 1-day; 4-hour worker re-entry interval instead of 48-hours or 24-hours);**
- **A reduced risk product with a new non-toxic mode of action for use in resistance management and integrated pest management (IPM); and**
- **Opportunities for export of the treated crop to Canada, Mexico, New Zealand, South Korea, Taiwan, and a growing list of additional countries.**

GRAPES / Bunch Rot (*Botrytis cinerea*)

Please see the tables below.

Serenade Optimum is retained in the reduce table from Step 2 based upon efficacy data from an unpublished trial summarized in the May 31, 2016 petition.

From Step 2:
Comparative Overview of Efficacy, Hazards, and Use Restrictions
Crop Group 13: Berries and Small Fruits: Grapes / Bunch Rot (*Botrytis cinerea*)

NOP Status	FRAC [A] Code(s)	Active Ingredient (s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Synthetic	19	Polyoxin D zinc salt	Oso	68173-4	66	6	See Oso efficacy summary table.	Control.	0	4	None.	May cause dermal sensitization. [F]	Moderately toxic to fish and aquatic invertebrates.	None.
Non-synthetic	44	*Bacillus amylo-liquefaciens* strain D747	Double Nickel 55	70051-108	74	1	9:SMF001.	Control. Preventative only.	0	4	None.	Moderate eye irritation. May cause dermal sensitization. [F]	None.	Water pH restrictions.
Non-synthetic	44	*Bacillus amylo-liquefaciens* strain D747	Double Nickel LC	70051-114	95	1	9:SMF001.	Control. Preventative only.	0	4	None.	Moderate eye irritation. May cause dermal sensitization. [F]	None.	Water pH restrictions.
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade Optimum	264-1160	32	1	9:SMF023.	Control. Preventative only.	0	4	None.	Moderate eye irritation. May cause dermal sensitization. [F]	None.	None.

A. FRAC = Fungicide Resistance Action Committee. Products with the same mode of action have the same FRAC Code. NC = Not classified; no FRAC code has been assigned.
B. For Polyoxin D zinc salt (Oso), from summarizes trials, published and unpublished. For OMRI-listed alternatives, from Plant Disease Management Reports (PDMR).
C. Number of trials included in the calculation of the mean.
D. PDMR = Plant Disease Management Reports (on-line journal generally used for publication of efficacy research conducted at universities). Preceded by F&N = Fungicides and Nematicides. https://www.plantmanagementnetwork.org/pub/trial/pdmr/
E. Mix-and-match directions for use. Label has a list of crops and a separate list of diseases with no claim for specific crop/disease combinations.
F. Complete label statement: Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals.
G. EPA relative toxicity descriptors, lowest toxicity to highest toxicity: Practically nontoxic < Moderately toxic < Toxic < Highly toxic.

Plant Disease Management Reports citations and data summaries for non-synthetic alternatives:

9:SMF001. T. T. Nguyen, N.S. Morris, and W. D. Gubler, University of California, Davis. Management of Grape Botrytis Bunch Rot with experimental, organic and conventional fungicides, 2014.
Double Nickel LC at 2 qt/A: 93% and 96% control of Botrytis bunch rot (severity and incidence, respectively). Trial mean: 95% control (n = 2).
Double Nickel 55WDG at 20 oz/A: 70% and 78% control of Botrytis bunch rot (severity and incidence, respectively). Trial mean: 74% control (n = 2).

From Step 1:
Cumulative Summary of the Efficacy of the Polyoxin D Zinc Salt 5SC Suspension Concentrate Fungicide (EPA Reg. No. 68173-4) and Oso 5%SC Fungicide (EPA Reg. No. 68173-4-70051) Applied as a Foliar Spray to Growing Food Crops Using Ground Application Equipment

Disease	Pathogen	Crop Tested & Sequence No.	Trial No.	State	Formulation [1]	No. App.	Application Interval (Days)	Application Rate		Mean Control (%)		Mean Yield Increase (%)	Application Type(s)	Inocu-lated?	Max. Pest Pressure in UTC (%)	Phyto-tox ?	Publication Status	Notes
								fl oz/ acre	g a.i./ ha	Leaves	Fruit							
CROP GROUP 13: BERRIES AND SMALL FRUITS: GRAPES																		
Bunch Rot	*Botrytis cinerea*	Grapes #1	CER-2013-002	CA	Tavano 5% SC	4	37 - 56	6.5	25	NA	89.0	NA	Preventative	No	30.00	No	Certis data; not published.	
								13	50	NA	92.8							
		Grapes #2	CER-2013-021	CA	Tavano 5% SC	6	18 - 21	6.5	25	NA	83.2	NA	Preventative and curative	No	20.8	No	Certis data; not published.	
								13	50	NA	78.1							
		Grapes #3	CER-2014-045	NY	Tavano 5% SC	4	13 - 43	6.5	25	NA	37	NA	Preventative and curative	No	76.3	No	Not published. Permission received.	
		Grapes #4	CER-2015-115	NY	OSO	4	14 - 41	6.5	25	NA	69	NA	Preventative	No	96	No	Not published. Permission received.	
		Grapes #5	CER-2015-140	MI	Oso 5%SC + Super Spread 90 (non-ionic surfactant; 0.125% v/v)	4	20 - 29	6.5	25	NA	56	NA	Preventative	No	25	No	PDMR 10:SMF011	
		Grapes #6	9:SMF001	CA	Tavano 5% SC	3	35	6.5	25	NA	61.1	NA	Preventative	No	22.8	No	PDMR 9:SMF001	New data.
							Mean	6.5	25	NA	66	NA						
								13	50	NA	85	NA						

1. "Veggieturbo 5SC Suspension Concentrate Fungicide" is Kaken's EPA registered brand name for Polyoxin D Zinc Salt 5SC Fungicide.
"Oso 5%SC Fungicide" and "Tavano 5%SC Fungicide" are Certis USA, L.L.C. supplemental distributor brand names for Polyoxin D Zinc Salt 5SC Fungicide.
"CX-10440" is the Certis USA, L.L.C. formulation code for Polyoxin D Zinc Salt 5SC Fungicide.

NR. Not reported.

Preventative and curative: Treatments include at least one application after disease was observed.
Curative: Disease was confirmed to be present before the first treatment was applied.

The polyoxin D zinc salt 5SC formulation provided 66% mean control of grape/bunch rot in 6 trials.

- Individual trial means were 90.9%, 80.7%, 37%, 69%, 56%, and 61.1% control of grape bunch rot in trial numbers CER-2013-002, CER-20123-021, CER-2014-045, CER-2015-115, CER-2015-140, and 9:SMF-001, respectively.
- Trial numbers CER-2013-002, CER-20123-021, CER-2014-045, CER-2015-115 are *not* published.
- Trial numbers CER-2015-140 and 9:SMF-001 are published.

Comparison with Serenade Optimum (Non-Synthetic)

Trial number CER-2013-002 (not published) was summarized in the May 31, 2016 petition and includes direct comparison of Tavano 5%SC (containing 5% polyoxin D zinc salt) with Serenade Optimum.

- Tavano applied at 13 fl oz/acre had numerically *superior* control grape bunch rot incidence compared to Serenade Optimum (98.1% control vs 93.3% control). Both products provided 87.5% control of grape bunch rot disease severity.
- Serenade Optimum is required to be applied preventatively. Oso can be applied after disease is first observed.

Comparison with Double Nickel LC (Non-Synthetic):

Direct comparisons of the efficacy of polyoxin D zinc salt 5SC formulation (a.k.a. Tavano) with Double Nickel LC are included in three trials:

Trial No.	Treatment	Rate/acre	Label Rate/Acre Range	Bunch Rot Incidence		Bunch Rot Severity		Publication
				Percent	Percent Control	Percent	Percent Control	
CER-2014-045	Untreated control			76.3 a		31.6 a		Not published; summarized in the May 31, 2016 petition
	Tavano 5SC	6.5 fl oz	6.5 - 13	60.0 a-f	21	14.9 b-e	53	
	Double Nickel LC	2.0 qt	0.5 - 6	62.5 a-d	18	14.8 b-e	54	
CER-2015-115	Untreated control			96 a		44 ab		Not published; summarized in the May 31, 2016 petition
	Tavano 5SC	6.5 fl oz	6.5 - 13	50 gh	50	12 d-f	88	
	Double Nickel LC	1 qt	0.5 - 6	86 a-d	14	23 de	77	
	Double Nickel LC	2 qt	0.5 - 6	48 h	53	11 ef	89	
9:SMF001	Untreated control			22.8a		4.4 a		PDMR 9:SMF001
	Tavano 5SC	6.5 fl oz	6.5 - 13	4.0 cd	82.5	1.5 bc	59.1	
	Double Nickel LC	2 qt	0.5 - 6	1.0 d	95.6	0.3 bc	93.2	

For trials with direct comparison of the polyoxin D zinc salt 5SC formulation (a.k.a. Tavano) with Double Nickel LC, the efficacy of the polyoxin D zinc salt 5SC formulation applied at the minimum label rate of 6.5 fl oz/acre was:

- Statistically *superior* to Double Nickle LC at 1 qt/acre (1 trial); and
- Statistically *equivalent* to Double Nickle LC at 2 qt/acre (each of 3 trials).

Double Nickle LC is required to be applied preventatively. Oso can be applied after disease is first observed.

Comparison with Double Nickel 55 (Non-Synthetic):
Direct comparisons of the efficacy of polyoxin D zinc salt 5SC formulation (a.k.a. Tavano) with Double Nickel 55 are included in one trial (9:SMF001):

Trial No.	Treatment	Rate/acre	Label Rate/Acre Range	Bunch Rot Incidence		Bunch Rot Severity		Publication
				Percent	Percent Control	Percent	Percent Control	
9:SMF001	Untreated control			22.8a		4.4 a		PDMR 9:SMF001
	Tavano 5SC	6.5 fl oz	6.5 - 13	4.0 cd	82.5	1.5 bc	59.1	
	Double Nickel 55	20 oz	0.3 - 3 lb = 4.8 - 48 oz	5.0 cd	78.1	1.3 bc	70.5	

In this direct comparison of the polyoxin D zinc salt 5SC formulation (a.k.a. Tavano) with Double Nickel 55, the efficacy of the polyoxin D zinc salt 5SC formulation applied at the *minimum* label rate of 6.5 fl oz/acre was statistically *equivalent* to that of the Double Nickel applied at 20 oz/acre (approximately the *middle* of the application rate range on the label).

Double Nickle 55 is required to be applied preventatively. Oso can be applied after disease is first observed.

CONCLUSION: The polyoxin D zinc salt 5SC formulation offers organic grape growers:

- **Competitive or superior efficacy for control of bunch rot;**
- **A treatment option *after* bunch rot is first observed;**
- **Competitive worker and environmental safety;**
- **A reduced risk product with a new non-toxic mode of action for use in resistance management and integrated pest management (IPM); and**
- **Opportunities for export of the treated crop to Canada, Mexico, New Zealand, South Korea, Taiwan, and a growing list of additional countries.**

GRAPES / Downy Mildew (*Plasmopara viticola*)

Please see the tables below.

From Step 2:
Comparative Overview of Efficacy, Hazards, and Use Restrictions
Crop Group 13: Berries and Small Fruits: Grapes / Downy Mildew (*Plasmopara viticola*)

NOP Status	FRAC [A] Code(s)	Active Ingredient (s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Synthetic	19	Polyoxin D zinc salt	Oso	68173-4	95	2	See Oso efficacy summary table.	Control.	0	4	None	May cause dermal sensitization. [F]	Moderately toxic to fish and aquatic invertebrates.	None.
Synthetic	M1	Copper oxychloride, Copper hydroxide	Badge X2	80289-12	99 (with lime)	1	8:SMF014	Control.	0	48	Yes	May be fatal if swallowed. Substantial eye injury.	Toxic to fish and aquatic organisms.	May damage aluminum.
Synthetic	M1	Copper octanoate	Cueva	67702-2-70051	93	1	3:SMF031	Control.	0	4	Yes	Harmful if swallowed or absorbed through skin.	Toxic to fish and aquatic organisms.	Do not store below 4°C (39°F). Tank-mix restrictions.
Synthetic	NC; Oxidizing agent	Hydrogen dioxide, Peroxyacetic acid	Oxidate 2.0	70299-2	92 (leaves)	1	5:SMF049.	Control.	0	Until dry	None	Irreversible eye damage. May be fatal if swallowed. Skin irritation.	Highly toxic to bees and other beneficial insects. Toxic to fish.	Chemical instabilities. Strong oxidizing agent. Use and storage temperature restrictions.

A. FRAC = Fungicide Resistance Action Committee. Products with the same mode of action have the same FRAC Code. NC = Not classified; no FRAC code has been assigned.
B. For Polyoxin D zinc salt (Oso), from summarizes trials, published and unpublished. For OMRI-listed alternatives, from Plant Disease Management Reports (PDMR).
C. Number of trials included in the calculation of the mean.
D. PDMR = Plant Disease Management Reports (on-line journal generally used for publication of efficacy research conducted at universities). Preceded by F&N = Fungicides and Nematicides. https://www.plantmanagementnetwork.org/pub/trial/pdmr/
E. Mix-and-match directions for use. Label has a list of crops and a separate list of diseases with no claim for specific crop/disease combinations.
F. Complete label statement: Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals.
G. EPA relative toxicity descriptors, lowest toxicity to highest toxicity: Practically nontoxic < Moderately toxic < Toxic < Highly toxic.

8:SMF014. B. Hed, Penn State University. Evaluation of organic fungicides for control of black rot and powdery and downy mildew of Concord grapes, 2013.
Badge X2 at 1.75 lb/A + lime at 1.75 lb/A, different application timings: 96%, 99%, 100%, and 100% control of downy mildew on grapes (fruit).
Badge X2 at 1.75 lb/A + lime at 1.75 lb/A + Nu-Film-P at 0.0625%, different application timings: 100% and 100% control of downy mildew on grapes (fruit).
Badge X2 trial mean: 99% control (n = 6).

5:SMF049. A. Schilder, *et al.* Michigan State University. Evaluation of fungicide programs for control of bunch rots and downy mildew in 'Vignoles' grapes, 2008.
Oxidate 1% (v/v): 92% control on grape leaves.

3:SMF031. B. Hed. Penn State Univ. Evaluation of alternative fungicides for control of black rot, powdery mildew, and downy mildew of grapes, 2008.
Cueva 1%: 93% control of downy mildew on grapes (fruit).

From Step 1:
Cumulative Summary of the Efficacy of the Polyoxin D Zinc Salt 5SC Suspension Concentrate Fungicide (EPA Reg. No. 68173-4) and Oso 5%SC Fungicide (EPA Reg. No. 68173-4-70051) Applied as a Foliar Spray to Growing Food Crops Using Ground Application Equipment

Disease	Pathogen	Crop Tested & Sequence No.	Trial No.	State	Formulation [1]	No. App.	Application Interval (Days)	Application Rate		Mean Control (%)		Mean Yield Increase (%)	Application Type(s)	Inocu-lated?	Max. Pest Pressure in UTC (%)	Phyto-tox ?	Publication Status	Notes
								fl oz/ acre	g a.i./ ha	Leaves	Fruit							
CROP GROUP 13: BERRIES AND SMALL FRUITS: GRAPES																		
Downy Mildew	*Plasmopara viticola*	Grapes #1	KAK-2016-Grape-MI	MI	Oso	7	7 - 16	6.5	25	92	NA	NA	Preventative	No	83.0	No	PDMR (Planned fall 2018 publication) (Permission)	New data.
								13	50	99	NA	NA						
		Grapes #2	KAK-2017-Grape-MI	MI	Oso	7	11 - 20	13	50	NA	95	NA	Preventative	No	78.0	No	PDMR (Planned fall 2018 publication) (Permission)	New data.
							Mean	6.5	25	92	NA	NA						
								13	50	99	95	NA						

1. "Veggieturbo 5SC Suspension Concentrate Fungicide" is Kaken's EPA registered brand name for Polyoxin D Zinc Salt 5SC Fungicide.
"Oso 5%SC Fungicide" and "Tavano 5%SC Fungicide" are Certis USA, L.L.C. supplemental distributor brand names for Polyoxin D Zinc Salt 5SC Fungicide.
"CX-10440" is the Certis USA, L.L.C. formulation code for Polyoxin D Zinc Salt 5SC Fungicide.

NR. Not reported.

Preventative and curative: Treatments include at least one application after disease was observed.
Curative: Disease was confirmed to be present before the first treatment was applied.

Based upon the mean of two trials, the polyoxin D zinc salt 5SC formulation provided comparable efficacy for the efficacy of downy mildew of grapes (95% control) compared to Badge X2 with lime (99% control), Cueva (93% control), and Oxidate (92% control).

Comparison to Badge X2, Cueva, and Oxidate (Synthetic)

The polyoxin D zinc salt 5SC formulation is a reduced risk product compared to Badge X2, Cueva, and Oxidate.

- Badge X2 is phytotoxic, has higher human toxicity (may be fatal if swallowed), and has higher environmental toxicity (toxic fish and aquatic organisms).
- Cueva has a phytotoxicity warning on its label ("may cause some copper toxicity on some plant species"), has higher acute toxicity (harmful if swallowed or absorbed through skin, and has higher environmental toxicity (toxic to fish and aquatic organisms).
- Oxidate is significantly more toxic to humans and environment. Oxidate causes irreversible eye damage and may be fatal if swallowed. Oxidate is highly toxic to bees and other beneficial insects and is toxic to fish.

CONCLUSION: The polyoxin D zinc salt 5SC formulation offers organic grape growers:

- **Competitive or superior efficacy for control of downy mildew;**
- **An opportunity to reduce the amount of copper applied to their vineyards and thereby reduce the negative effects of copper on soil;**
- **Greater to significantly greater crop, worker, and environmental safety;**
- **Reduced (EPA's minimum) personal protective equipment requirement;**
- **Greater flexibility in growing the crop [0-day PHI instead of 1-day PHI; 4-hour worker re-entry interval instead of 48 hours (Badge X2)];**
- **A reduced risk product with a new non-toxic mode of action for use in resistance management and integrated pest management (IPM); and**
- **Opportunities for export of the treated crop to Canada, Mexico, New Zealand, South Korea, Taiwan, and a growing list of additional countries.**

GRAPES / Powdery Mildew (*Erisyphe necator*)

Please see the tables below.

Rows for Double Nickel LC, Stargus, Lifegard WG, and Badge X2 are retained in the table from Step 2 to facilitate comparisons with these products based upon unpublished data.

From Step 2:
Comparative Overview of Efficacy, Hazards, and Use Restrictions
Crop Group 13: Berries and Small Fruits: Grapes / Powdery Mildew (*Erisyphe necator*)

NOP Status	FRAC [A] Code(s)	Active Ingredient (s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Synthetic	19	Polyoxin D zinc salt	Oso	68173-4	79	8	See Oso efficacy summary table.	Control.	0	4	None	May cause dermal sensitization. [F]	Moderately toxic to fish and aquatic invertebrates.	None.
Non-synthetic	44	*Bacillus amylo-liquefaciens* strain D747	Double Nickel LC	70051-114	No data	NA	NA	Control. Preventative only.	0	4	None.	Moderate eye irritation. May cause dermal sensitization. [F]	None.	Water pH restrictions.
Non-synthetic	44	*Bacillus amylo-liquefaciens* strain F727	Stargus	84059-28	No data			Control. Preventative only.	0	4	None.	Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Not for sale or use after 18 months from the date of manufacture. Avoid freezing.
Non-synthetic	44	*Bacillus mycoides*, isolate J	LifeGard WG	70051-119	No data			No direct effect on plant pathogen; plant protectant; preventative.	0	4	None.	Harmful if inhaled. Moderate eye irritation. Respirator required; repeated exposure to high concentrations of microbial proteins can cause allergic sensitization.	None.	Store at temperatures below 77°F.
Synthetic	M1	Copper hydroxide, Copper oxychloride	Badge X2	80289-12	50	2	8:SMF014 6:SMF008	Control.	0	48	Yes.	May be fatal if swallowed. Substantial eye injury.	Toxic to fish and aquatic organisms.	May damage aluminum.
Synthetic	M2	Sulfur	Micro Sulf	55146-75	88	1	6:SMF025	Control.	0	24	Yes	Harmful if swallowed, inhaled, or absorbed through skin. Eye irritation.	None.	Keep away from heat, sparks, or flames.

From Step 2:
Comparative Overview of Efficacy, Hazards, and Use Restrictions
Crop Group 13: Berries and Small Fruits: Grapes / Powdery Mildew (*Erisyphe necator*)

NOP Status	FRAC [A] Code(s)	Active Ingredient (s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical

A. FRAC = Fungicide Resistance Action Committee. Products with the same mode of action have the same FRAC Code. NC = Not classified; no FRAC code has been assigned.
B. For Polyoxin D zinc salt (Oso), from summarizes trials, published and unpublished. For OMRI-listed alternatives, from Plant Disease Management Reports (PDMR).
C. Number of trials included in the calculation of the mean.
D. PDMR = Plant Disease Management Reports (on-line journal generally used for publication of efficacy research conducted at universities). Preceded by F&N = Fungicides and Nematicides. https://www.plantmanagementnetwork.org/pub/trial/pdmr/
E. Mix-and-match directions for use. Label has a list of crops and a separate list of diseases with no claim for specific crop/disease combinations.
F. Complete label statement: Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals.
G. EPA relative toxicity descriptors, lowest toxicity to highest toxicity: Practically nontoxic < Moderately toxic < Toxic < Highly toxic.

Plant Disease Management Reports citations and data summaries for synthetic alternatives:

6:SMF025. N. O. Halbrendt, H.K. Ngugi, and J. M. Halbrendst, Penn State University. Performance of organic and conventional programs for powdery mildew management on wine grapes in PA, 2011.
Micro Sulf at 5 lb/A: 10.0%, 99.7%, 94.7%, and 99.7% control on leaves (incidence and severity, respectively; Chamboucin and Traminette, respectively).
Micro Sulf at 5 lb/A: 100%, 100%, 100%, and 100% control on clusters (incidence and severity, respectively; Chamboucin and Traminette, respectively).
Trial mean: 88% (n = 8).

From Step 1:
Cumulative Summary of the Efficacy of the Polyoxin D Zinc Salt 5SC Suspension Concentrate Fungicide (EPA Reg. No. 68173-4) and Oso 5%SC Fungicide (EPA Reg. No. 68173-4-70051) Applied as a Foliar Spray to Growing Food Crops Using Ground Application Equipment

Disease	Pathogen	Crop Tested & Sequence No.	Trial No.	State	Formulation [1]	No. App.	Application Interval (Days)	Application Rate		Mean Control (%)		Mean Yield Increase (%)	Application Type(s)	Inoculated?	Max. Pest Pressure in UTC (%)	Phyto-tox ?	Publication Status	Notes
								fl oz/ acre	g a.i./ ha	Leaves	Fruit							
CROP GROUP 13: BERRIES AND SMALL FRUITS: GRAPES																		
Powdery mildew	*Erysiphe necator*	Grapes #1	CER-2011-013	CA	CX-10440	8	10 - 11	3.75	14	78.1	78.6	NA	Preventative and curative	No	70.3	No	Certis data; not published.	
								7.5	29	80.4	68.8							
		Grapes #2	CER-2012-069	CA	CX-10440	8	9 - 11	13	50	NA	96.67	NA	Preventative and curative	No	30.00	No	Certis data; not published.	Wine was analyzed.
		Grapes #3	CER-2013-021	CA	Tavano	5	18 - 21	6.5	25	NA	44.2	NA	Preventative and curative	No	100	No	Certis data; not published.	
								13	50	NA	73.6	NA						
		Grapes #4	CER-2015-019	OR	Oso + Sylguard (silicone surfactant; 0.025% v/v)	6	13 - 15	6.5	25	86.1	47.9	NA	Preventative and curative	No	87.5	No	Certis data; not published.	
		Grapes #5	CER-2015-140	MI	Oso 5%SC + Super Spread 90 (non-ionic surfactant; 0.125% v/v)	4	20 - 29	6.5	25	55	56	NA	Preventative	No	37	No	PDMR 10:SMF011	
		Grapes #6	KAK-2016-Grape-MI	MI	Oso	7	10 - 16	6.5	25	90	88	NA	Preventative	No	63.0	No	PDMR (Planned fall 2018) (Permission)	New data.
								13	50	99	99							
		Grapes #7	KAK-2017-Grape-MI	MI	Oso	7	11 - 20	13	50	97	99	NA	Preventative	No	85.0	No	PDMR (Planned fall 2018) (Permission)	New data.
		Grapes #8	KAK-2017-Grape-PA	PA	Oso	7	9 - 11	13	50	81	84	NA	Preventative	No	98.0	No	PDMR (Planned fall 2018) (Permission)	New data.
							Mean	3.75	14	78.1	78.6	NA						
								6.5 - 7.5	25 - 29	78	61	NA						
								13	50	92	90	NA						

1. "Veggieturbo 5SC Suspension Concentrate Fungicide" is Kaken's EPA registered brand name for Polyoxin D Zinc Salt 5SC Fungicide.
"Oso 5%SC Fungicide" and "Tavano 5%SC Fungicide" are Certis USA, L.L.C. supplemental distributor brand names for Polyoxin D Zinc Salt 5SC Fungicide.
"CX-10440" is the Certis USA, L.L.C. formulation code for Polyoxin D Zinc Salt 5SC Fungicide.

NR. Not reported.

Preventative and curative: Treatments include at least one application after disease was observed.
Curative: Disease was confirmed to be present before the first treatment was applied.

The polyoxin D zinc salt 5SC formulation provided mean 79% control powdery mildew in grapes based upon *8 efficacy trials*. Individual trial means were 76.5%, 96.67%, 58.9%, 67%, 56%, 94%, 98%, and 83% control in trial numbers CER-2011-013, CER-2012-069, CER-2013-021, CER-2015-019, CER-2015-140, KAK-2016-Grape-MI, KAK-2017-Grape-MI, and KAK-2017-Grape-PA, respectively.

Comparison with Micro Sulf (Synthetic)

In a single trial, Micro Sulf provided mean 88% control of powdery mildew on grapes. This is:

- Within the range of the 8 trials for Oso; and
- Less than the 96.67%, 94%, and 98% control by Oso observed in trial numbers CER-2012-069, KAK-2016-Grape-MI, and KAK-2017-Grape-MI.

The polyoxin D zinc salt 5 SS formulation:

- Is not phytotoxic, whereas Micro Sulf is phytotoxic.
- Has lower mammalian toxicity. Micro Sulf is harmful if swallowed, inhaled, or absorbed through skin and causes eye irritation.

Other OMRI-Listed Alternatives

For the first 6 listed trials, no OMRI-listed alternatives were included in the trial.

Two trials which are not yet published for which summaries are included in this document each include direct comparisons of the polyoxin D zinc salt 5SC formulation to two OMRI-listed products:

- Trial No. KAK-2017-Grape-MI includes Lifegard WG and Stargus; and
- Trial No. KAK-2017-Grape-PA includes Double Nickel LC and Badge X2 with lime.

Comparison with Lifegard WG and Stargus (Non-Synthetic)

In Trial No. KAK-2017-Grape-MI, the polyoxin D zinc salt 5SC formulation provided:

- Statistically *equivalent* control of powdery mildew on grapes *leaves* compared to Lifegard WG and Stargus (97%, 94%, and 96% control, respectively); and
- Statistically *superior* control of powdery mildew on grapes *clusters* compared to Lifegard WG and Stargus (99%, 97%, and 97% control, respectively).

For both Lifeguard WG and Stargus:

- The US EPA registration is limited to preventative use only; and
- Applicators are required to wear a respirator.

The polyoxin D zinc salt 5SC formulation does not have either of these limitations.

Comparison with Double Nickel LC (Non-Synthetic)

In Trial No. KAK-2017-Grape-PA, the polyoxin D zinc salt 5SC formulation provided:

- Numerically *superior* control of powdery mildew on grape *leaves* (81%) compared to Double Nickel LC at 1.5 qt/acre and 3 qt/acre (56% and 39%), respectively; and
- Numerically *superior* control of powdery mildew on grape *clusters* (84%) compared to Double Nickel LC at 1.5 qt/acre and Double Nickel LC at 3 qt/acre (24%, and 17%, respectively).

Double Nickel is required to be used preventatively. Oso can be applied after disease is first observed.

Comparison with Badge X2 Tank-Mixed with Lime (Synthetic)

In Trial No. KAK-2017-Grape-PA, the polyoxin D zinc salt 5SC formulation provided:

- Statistically *equivalent* control of powdery mildew on grape *leaves* (81%) compared to Badge X2 tank-mixed with lime (97%); and
- Numerically *superior* control of powdery mildew on grape *clusters* (84%) compared to Badge X2 tank-mixed with lime (59%).

The polyoxin D zinc salt 5SC formulation is a reduced risk product relative to Badge X2. The polyoxin D zinc salt 5SC formulation:

- Is not phytotoxic, whereas Badge X2 is phytotoxic.
- Is practically non-toxic in all acute toxicity categories, whereas Badge X2 is harmful if swallowed, inhaled, or absorbed through skin and is an eye irritant. This difference is partially off-set by the polyoxin D zinc salt 5SC formulation's moderate toxicity to fish and aquatic organisms and no similar label statement for Badge X2.

CONCLUSION: The polyoxin D zinc salt 5SC formulation offers organic grape growers:

- **Competitive or superior efficacy for control of powdery mildew;**
- **A treatment option *after* powdery mildew is first observed;**
- **An opportunity to reduce the amount of copper applied to their vineyards and thereby reduce the negative effects of copper on soil;**
- **Competitive or superior crop, worker, and environmental safety;**
- **Greater flexibility in growing the crop [0-day PHI instead of 1-day PHI; 4-hour worker re-entry interval instead of 48 hours (Badge X2)];**
- **Increased applicator comfort (no respirator is required as is required for Lifegard WG and Stargus);**
- **A reduced risk product with a new non-toxic mode of action for use in resistance management and integrated pest management (IPM); and**
- **Opportunities for export of the treated crop to Canada, Mexico, New Zealand, South Korea, Taiwan, and a growing list of additional countries.**

STRAWBERRIES / Phomopsis Leaf Spot (Blight) (*Phomopsis obscurans*)

Please see the tables below.

From Step 2:
Comparative Overview of Efficacy, Hazards, and Use Restrictions
Crop Group 13: Berries and Small Fruits: Strawberries / Phomopsis Leaf Spot (Blight) (*Phomopsis obscurans*)

NOP Status	FRAC [A] Code(s)	Active Ingredient (s)	Product	EPA Reg. No.	Efficacy [B]			Label Claim	PHI (Days)	REI (Hrs)	Hazards and Restrictions Noted on the Product Label			
					Mean % Control	n [C]	PDMR [D] Citations				Phyto-toxicity	Human	Environmental [G]	Physical
Synthetic	19	Polyoxin D zinc salt	Oso	68173-4	91	2	See Oso efficacy summary table.		0	4	None	May cause dermal sensitization. [F]	Moderately toxic to fish and aquatic invertebrates.	None.
Synthetic	M1	Copper octanoate	Cueva	67702-2-70051	94	1	9:SMF035	Control.	0	4	Yes	Harmful if swallowed or absorbed through skin.	Toxic to fish and aquatic organisms.	Do not store below 4°C (39°F). Tank-mix restrictions.

A. FRAC = Fungicide Resistance Action Committee. Products with the same mode of action have the same FRAC Code. NC = Not classified; no FRAC code has been assigned.
B. For Polyoxin D zinc salt (Oso), from summarizes trials, published and unpublished. For OMRI-listed alternatives, from Plant Disease Management Reports (PDMR).
C. Number of trials included in the calculation of the mean.
D. PDMR = Plant Disease Management Reports (on-line journal generally used for publication of efficacy research conducted at universities). Preceded by F&N = Fungicides and Nematicides. https://www.plantmanagementnetwork.org/pub/trial/pdmr/
E. Mix-and-match directions for use. Label has a list of crops and a separate list of diseases with no claim for specific crop/disease combinations.
F. Complete label statement: Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals.
G. EPA relative toxicity descriptors, lowest toxicity to highest toxicity: Practically nontoxic < Moderately toxic < Toxic < Highly toxic.

Plant Disease Management Reports citations and data summaries:

9:SMF035. A. Schilder *et al.*, Michigan State University. Evaluation of organic fungicides for control of strawberry foliar and fruit diseases, 2014.
Cueva at 1 gal/A: 94% control of Phomopsis leaf blight.

From Step 1:
Cumulative Summary of the Efficacy of the Polyoxin D Zinc Salt 5SC Suspension Concentrate Fungicide (EPA Reg. No. 68173-4) and Oso 5%SC Fungicide (EPA Reg. No. 68173-4-70051) Applied as a Foliar Spray to Growing Food Crops Using Ground Application Equipment

Disease	Pathogen	Crop Tested & Sequence No.	Trial No.	State	Formulation [1]	No. App.	Application Interval (Days)	Application Rate		Mean Control (%)		Mean Yield Increase (%)	Application Type(s)	Inocu-lated?	Max. Pest Pressure in UTC (%)	Phyto-tox ?	Publication Status	Notes
								fl oz/ acre	g a.i./ ha	Leaves	Fruit							
CROP GROUP 13: BERRIES AND SMALL FRUITS: STRAWBERRIES																		
Phomopsis Leaf Spot and Fruit Rot	*Phomopsis obscurans*	Strawberries #1	KAK-2016-SBerry-MI	MI	Oso	7	6 - 9	6.5	25	98	NA	4-day post-harvest: 240	Preventative	No	39.5	No	PDMR (Planned fall 2018 publication) (Permission)	New data.
								13	50	100	NA	273						
		Strawberries #2	KAK-2017-SBerry-MI	MI	Oso	5	7 - 14	13	50	83	80	4-day post-harvest: 2350	Preventative	No	35.1	No	PDMR (Planned fall 2018 publication) (Permission)	New data.
							Mean	6.5	25	98	NA	4-day post-harvest: 240						
								13	50	92	80	1312						

1. "Veggieturbo 5SC Suspension Concentrate Fungicide" is Kaken's EPA registered brand name for Polyoxin D Zinc Salt 5SC Fungicide.
"Oso 5%SC Fungicide" and "Tavano 5%SC Fungicide" are Certis USA, L.L.C. supplemental distributor brand names for Polyoxin D Zinc Salt 5SC Fungicide.
"CX-10440" is the Certis USA, L.L.C. formulation code for Polyoxin D Zinc Salt 5SC Fungicide.

NR. Not reported.

Preventative and curative: Treatments include at least one application after disease was observed.
Curative: Disease was confirmed to be present before the first treatment was applied.

The mean control of strawberry Phomopsis leaf spot (blight) for the polyoxin D zinc salt 5SC formulation based upon two trials is 91%. Mean control was 99% and 83% based upon Trial Numbers KAK-2016-SBerry-MI and KAK-2017-SBerry-MI, respectively. Summaries of both of these trials are included in this document. Both trials are not yet published. Trial Numbers KAK-2016-SBerry-MI and KAK-2017-SBerry-MI do *not* included data on any OMRI-listed products that are EPA registered for use on strawberries for treatment of Phomopsis.

Comparison with Cueva (Synthetic)

Cueva provided 94% control of strawberry phomopsis leaf spot in a single published efficacy trial. This is between the 83% and 99% control seen for the polyoxin D zinc salt 5SC formulation.

The polyoxin D zinc salt 5SC formulation is a reduced risk product compared to Cueva. Cueva has a phytotoxicity warning on its label ("may cause some copper toxicity on some plant species"), has higher acute toxicity (harmful if swallowed or absorbed through skin, and has higher environmental toxicity (toxic to fish and aquatic organisms).

CONCLUSION: The polyoxin D zinc salt 5SC formulation offers organic strawberry growers:

- **Competitive efficacy for control of Phomopsis leaf spot;**
- **A treatment option *after* Phomopsis leaf spot is first observed;**
- **Competitive or superior crop, worker, and environmental safety;**
- **A reduced risk product with a new non-toxic mode of action for use in resistance management and integrated pest management (IPM); and**
- **Opportunities for export of the treated crop to Canada, Mexico, New Zealand, South Korea, Taiwan, and a growing list of additional countries.**

OVERALL CONCLUSION

Based upon *disease significance and efficacy data alone*, there is *organic grower need* for the polyoxin D zinc salt 5SC formulation (a.k.a. Oso) for treatment of:

- **Blueberries for control of:**
  - **Alternaria blight (*Alternaria* spp.); and**
  - **Botrytis blight (*Botrytis cinerea*);**
- **Caneberries for control of:**
  - **Botrytis fruit rot (*Botrytis cinerea*); and**
  - **Powdery mildew (*Podosphaera aphanais*);**
- **Cranberries for control of:**
  - **Cottonball (Monilinia oxycocci); and**
  - **Fruit rot complex (*Coleophoma empetri*, *Colletotrichum acutatum*, *Colletotrichum gloeosporioides*, *Phyllosticta vaccinii*, and *Physalospora vaccinii*, etc.);**
- **Grapes for control of:**
  - **Phomopsis fruit rot (*Phomopsis viticola*);**
- **Strawberries for control of:**
  - **Anthracnose fruit rot (*Colletotrichum acutatum*);**
  - **Gray mold (*Botrytis cinerea*);**
  - **Leather rot (*Phytophthora cactorum*; and**
  - **Phomopsis fruit rot (soft rot) (*Phomopsis obscurans*); and**
- **Basil for control of:**
  - **Downy mildew (*Peronospora belbahrii*).**

OMRI-listed alternatives initially identified as having comparable or superior efficacy and therefore identified for more detailed comparisons were:

- **Blueberries/mummyberry (*Monilinia vaccinii-corymbosi*): Optiva;**
- **Grapes black rot (*Guignardia bodwellii*): Badge X2 and Nu-Cop 50 WP;**
- **Grapes/bunch rot (*Botrytis cinerea*): Double Nickel 55 and Double Nickel LC;**
- **Grapes/downy mildew (*Plasmopara viticola*): Badge X2, Cueva, and Oxidate;**
- **Grapes/powdery mildew (*Erysiphe necator*): Micro Sulf, Lifegard WG and Stargus; and**
- **Strawberries/Phomopsis leaf spot (*Phomopsis obscurans*): Cueva.**

Based upon *efficacy data and other considerations*, there is *organic grower need* for the polyoxin D zinc salt 5SC formulation (a.k.a. Oso) for treatment of:

- **Blueberries for control of mummyberry (*Monilinia vaccinii-corymbosi*). Compared to Optiva, the polyoxin D zinc salt 5SC formulation offers organic blueberry growers:**
  - **Competitive efficacy for control of mummyberry;**
  - **Competitive worker and environmental safety;**
  - **A treatment option *after* mummyberry is first observed;**
  - **A reduced risk product with a new non-toxic mode of action for use in resistance management and integrated pest management (IPM); and**
  - **Opportunities for export of the treated crop to Canada, Mexico, New Zealand, South Korea, Taiwan, and a growing list of additional countries.**

- **Grapes for the control of black rot (*Guignardia bodwellii*). Compared to Badge X2 and Nu-Cop 50 WP, the polyoxin D zinc salt 5SC formulation offers organic grape growers:**
  - **Competitive efficacy for control of black rot;**
  - **Greater crop, worker, and environmental safety;**
  - **An opportunity to reduce the amount of copper applied to their vineyards and thereby reduce the negative effects of copper on soil;**
  - **Reduced (EPA's minimum) personal protective equipment requirement;**
  - **Greater flexibility in growing the crop (0-day PHI instead of 1-day; 4-hour worker re-entry interval instead of 48-hours or 24-hours);**
  - **A reduced risk product with a new non-toxic mode of action for use in resistance management and integrated pest management (IPM); and**
  - **Opportunities for export of the treated crop to Canada, Mexico, New Zealand, South Korea, Taiwan, and a growing list of additional countries.**

- **Grapes for the control of bunch rot (*Botrytis cinerea*). Compared to Double Nickel 55 and Double Nickel LC, the polyoxin D zinc salt 5SC formulation offers organic grape growers:**
  - **Competitive or superior efficacy for control of bunch rot;**
  - **A treatment option *after* bunch rot is first observed;**
  - **Competitive worker and environmental safety;**
  - **A reduced risk product with a new non-toxic mode of action for use in resistance management and integrated pest management (IPM); and**
  - **Opportunities for export of the treated crop to Canada, Mexico, New Zealand, South Korea, Taiwan, and a growing list of additional countries.**

- **Grapes for the control of downy mildew (*Plasmopara viticola*). Compared to Badge X2, Cueva, and Oxidate, the polyoxin D zinc salt 5SC formulation offers organic grape growers:**
  - **Competitive or superior efficacy for control of downy mildew;**
  - **Greater to significantly greater crop, worker, and environmental safety;**
  - **Reduced (EPA's minimum) personal protective equipment requirement;**
  - **Greater flexibility in growing the crop [0-day PHI instead of 1-day PHI; 4-hour worker re-entry interval instead of 48 hours (Badge X2)];**
  - **A reduced risk product with a new non-toxic mode of action for use in resistance management and integrated pest management (IPM); and**
  - **Opportunities for export of the treated crop to Canada, Mexico, New Zealand, South Korea, Taiwan, and a growing list of additional countries.**

- **Grapes for control of powdery mildew (*Erysiphe necator*). Compared to Micro Sulf, Lifegard WG, Stargus, and Serifel, the polyoxin D zinc salt 5SC formulation offers organic grape growers:**
  - **Competitive or superior efficacy for control of powdery mildew;**
  - **A treatment option *after* powdery mildew is first observed;**
  - **Competitive or superior crop, worker, and environmental safety;**
  - **Greater flexibility in growing the crop [0-day PHI instead of 1-day PHI; 4-hour worker re-entry interval instead of 48 hours (Badge X2)];**
  - **Increased applicator comfort (no respirator is required as is required for Lifegard WG and Stargus);**
  - **A reduced risk product with a new non-toxic mode of action for use in resistance management and integrated pest management (IPM); and**
  - **Opportunities for export of the treated crop to Canada, Mexico, New Zealand, South Korea, Taiwan, and a growing list of additional countries.**

- **Strawberries for control of Phomopsis leaf spot (*Phomopsis obscurans*). Compared to Cueva, the polyoxin D zinc salt 5SC formulation offers organic strawberry growers:**
  - **Competitive efficacy for control of Phomopsis leaf spot;**
  - **A treatment option *after* Phomopsis leaf spot is first observed;**
  - **Competitive or superior crop, worker, and environmental safety;**
  - **A reduced risk product with a new non-toxic mode of action for use in resistance management and integrated pest management (IPM); and**
  - **Opportunities for export of the treated crop to Canada, Mexico, New Zealand, South Korea, Taiwan, and a growing list of additional countries.**

Please note:

- **For scheduling reasons, this analysis is limited to berries and small fruits and basil. Similar results are anticipated if other crop/disease combinations were analyzed.**
- **There is no EPA registered, OMRI-listed alternative for treatment of cranberries for control of cottonball (*Monilinia oxycocci*).**

COMPATIBILITY WITH OMRI-LISTED FUNGICIDES

ACTINOVATE, REGALIA, AND NOVASOURCE'S LIME-SULFUR

Blueberry/mummyberry trial #5 (Trial No. KAK-2016-Blueberry-WA-Org) is summarized above and is provided again below because it provides examples of how Oso can be an important addition to treatment programs with OMRI-listed products.

a. Design

Blueberry / Mummyberry (*Monilinia vaccinii-corymbosi*) #5: Trial No. KAK-2016-Blueberry-WA-Org: Design				
Title:	Organic Mummy Berry & Botrytis Control in Blueberries of Western Washington 2016			
Author and affiliation:	Alan Schreiber Agricultural Development Group, Inc.			
Publication:	Not published; permission received.			
Location:	Mt. Vernon, Washington			
Crop:	Highbush Blueberry (variety: Reka)			
Disease name:	Mummy berry			
Pathogen:	*Monilinia vaccinii-corymbosi*			
Test plot design:	Randomized complete block			
Number of replicates:	4			
Application equipment:	Rears OverRo			
Spray volume:	100 gallons/acre			
Application type(s):	Preventative			
Number of applications:	7			
Chronology:	Application Dates	Application Interval	Growth Stage	Evaluation Dates
	02/27/2016		Veg Bud	05/03/2016
	03/07/2016	9 days	Veg Tip	06/23/2016
	03/16/2016	9 days	Pre Bud	
	03/25/2016	9 days	Pink Bud	
	03/31/2016	6 days	10% Bloom	
	04/08/2016	9 days	30% Bloom	
	04/15/2016	7 days	50% Bloom	

b. Results

Blueberries / Mummyberry (*Monilinia vaccinii-corymbosi*) #5: Trial No. KAK-2016-Blueberry-WA-Org: Results									
Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	Appl Code	Incidence Leaf Strikes/Plot) (05/03/2016)		Incidence (Infected Fruit) (06/23/2016)	
						Measured	Percent Control	Measured	Percent Control
Untreated control			Not Applicable			16.0 abc		45.0 a	
Oso 5%SC	6.5 fl oz	25	Polyoxin D zinc salt	19	ABCDEF	26.3 a	-64.4	37.0 a	17.8
Oso 5%SC	13 fl oz	50	Polyoxin D zinc salt	19	ABCDEF	10.8 c	32.5	31.5 a	30.0
Fracture	20 fl oz		Banda de Lupinus albus doce (BLAD)	M12	ABCDEFG	21.0 abc	-31.3	39.8 a	11.6
Zen-O-Spore	4 lb		*Ulocladium oudemansii* (U3 Strain)	NC	ABCDEFG	18.0 abc	-12.5	32.5 a	27.8
Actinovate AG	12 oz		*Streptomyces lydicus* WYEC 108	NC	ABCDEFG	16.8 abc	-5.0	39.0 a	13.3
Double Nickel LC	1 qt		*Bacillus amyloliquefaciens* str. D747	44	ABCDEFG	12.8 bc	20.0	33.5 a	25.6
Regalia	2 qt		*Reynoutria sachalinensis* extract	P5	ABCDEFG	12.0 c	25.0	39.0 a	13.3
NovaSource's Lime-Sulfur	2% v/v		Calcium polysulfide	M2	ABCD	9.8 c	38.8	36.0 a	20.0
Oso 5%SC	13 fl oz		Polyoxin D zinc salt	19	BDF	25.3 ab	-58.1	24.3 a	46.0
Actinovate AG	12 oz		*Streptomyces lydicus* WYEC 108	NC	ACEG				
Oso 5%SC	13 fl oz		Polyoxin D zinc salt	19	BDF	20.8 abc	-30.0	32.8 a	27.1
Regalia	2 qt		*Reynoutria sachalinensis* extract	P5	ACEG				
Actinovate AG	12 oz		*Streptomyces lydicus* WYEC 108	NC	ACEG				
Oso 5%SC	13 fl oz		Polyoxin D zinc salt	19	EFG	15.8 abc	1.3	29.3 a	34.9
NovaSource's Lime-Sulfur	2% v/v		Calcium polysulfide	M2	ABCD				
Oso 5%SC	13 fl oz		Polyoxin D zinc salt	19	ACEG	21.5 abc	-34.4	25.8 a	42.7
Regalia	2 qt		*Reynoutria sachalinensis* extract	P5	BDF				
Actinovate AG	12 oz		*Streptomyces lydicus* WYEC 108	NC	ACEG	22.0 abc	-37.5	39.0 a	13.3
Regalia	2 qt		*Reynoutria sachalinensis* extract	P5	ACEG				
Double Nickel LC	1 qt		*Bacillus amyloliquefaciens* str. D747	44	BDF				
Zen-O-Spore	4 lb		*Ulocladium oudemansii* (U3 Strain)	NC	BDF				
Treatment means followed by the same letter are not statistically different according to Bartlett's X2 test at P = 0.05.									

The first application was made on February 27, 2016. Based upon feedback from Washington State University plant pathologists, this was prior to ascospore release (i.e., prior to crop infection). Therefore, the treatments were applied preventatively.

The researcher described the mummyberry pressure as moderate.

No phytotoxicity was reported.

c. Discussion

Used alone:

- Actinovate (containing *Streptomyces lydicus* WYEC 108; no FRAC Code; biological);
- Regalia (containing *Reynoutria sachalinensis* extract; FRAC Code P5), and
- NovaSource's Lime-Sulfur (containing calcium polysulfide; FRAC Code M2)

each provided control of mummyberry fruit infections (fruit strikes) on blueberries that was better than the untreated control.

Oso enhanced the performance of Actinovate, Regalia, and NovaSource's Lime-Sulfur in the treatment of blueberries for control of mummyberry.

When Oso was used in combination with:

- Actinovate, better control of blueberry/ mummyberry fruit strikes (46.0 % control) was achieved than when Actinovate was used alone (13.3% control).
- Regalia, better control of blueberry/ mummyberry fruit strikes (42.7% control) was achieved than when Regalia was used alone (13.3% control).
- Regalia and Actinovate, better control of blueberry/ mummyberry fruit strikes (27.1% control) was achieved than when Regalia was used alone (13.3% control) and when Actinovate was used alone (also 13.3% control).
- NovaSource's Lime-Sulfur, better control of blueberry/mummyberry fruit strikes (34.9% control) was achieved than when NovaSource's Lime-Sulfur was used alone (20.0% control).

DOUBLE NICKEL LC

a. Design

Powdery Mildew (*Sphaerotheca fuliginea*) / Squash: Trial No. CER-2014-064: Design		
Title:	CER-2014-064	
Author and affiliation:	Gary Cloud	
Publication:	Not published. Certis data. Permission.	
Location:	Quitman, GA	
Crop:	Squash (Yellow crook neck)	
Disease name:	Powdery mildew	
Pathogen:	*Sphaerotheca fuliginea*	
Application codes and dates:	A	06/21/2014
	B	06/28/2014
	C	07/04/2014
	D	07/11/2014
	E	07/18/2014
	F	07/25/2014
	G	08/01/2014
	H	08/08/2014

b. Results

Powdery Mildew (*Sphaerotheca fuliginea*) / Squash: Trial No. CER-2014-064: Results									
Treatment	Rate/ Acre	g a.i./ ha	Active Ingredient	FRAC Code	App. Code	Yield (lb) 08/08/2014		Yield (lb) 08/15/2014	
						Measured	Percent Increase	Measured	Percent Increase
Untreated control			Not Applicable			5.38 b		8.78 a	
Double Nickel [A]	1 qt		*Bacillus amyloliquefaciens* strain 747	44	A-H	5.59 b	3.9	8.18 a	-6.8
Double Nickel [A]	1 qt		*Bacillus amyloliquefaciens* strain 747	44	ACEG	6.99 b	29.9	9.83 a	12.0
Oso	6.5 fl oz	25	Polyoxin D zinc salt	19	BDFH	12.48 a	132.0	12.00 a	36.7
Double Nickel [A]	1 qt		*Bacillus amyloliquefaciens* strain 747	44	ACEG				

Treatment means followed by the same letter are not statistically different according to the Student-Newman-Keuls test at P = 0.05.

A. The formulation (55 vs LC) was not specified. LC (liquid concentrate) is inferred based upon the units (quarts/acre) of the application rates.

c. Discussion

Yellow crook neck squash plants were treated using three different treatment patterns:

- Eight Double Nickel LC applications at 7-day intervals;
- Four Double Nickel LC applications at 14-day intervals; and
- Eight applications total at 7-day intervals, with Double Nickel LC applied first and then alternated with Oso for the balance of the treatment program.

The largest yield increases relative to the untreated control were obtained when Double Nickle LC applications were alternated with Oso applications (132.0% increase for harvest 1 and 36.7% increase for harvest 2).

Therefore, Oso enhanced the performance of Double Nickel LC in the treatment of squash for control of powdery mildew.

NOT RECOMMENDED FOR USE WITH *TRICHODERMA* SPECIES

Polyoxin D zinc salt stops the growth of sensitive fungi. Therefore, Kaken does not recommend the use of polyoxin D zinc salt as a tank-mix partner or as part of the treatment program with products containing *Trichoderma* species:

- Bio-Tam (EPA Reg. No. 80289-9) contains at least:
  - 5 million *Trichoderma asperellem* (ICC 012) colony forming units ; and
  - 5 million *Trichoderma gamsii* (ICC 080) colony forming units

  and is registered for control of *Phytophthora* which is the genus that causes leather rot of strawberries.
- Rootshield Plus WP (EPA Reg. No. 68539-9) contains at least:
  - 10 million *Trichoderma harzianum* Rifai strain T-22 colony forming unit per gram dry weight; and
  - 5.3 million *Trichoderma virens* strain G-41 colony forming unit per gram dry weight

  and is registered for control of *Phytophthora* which is the genus that causes leather rot of strawberries.
- Rootshield Plus Granules (EPA Reg. No. 68539-10) contains at least:
  - 10 million *Trichoderma harzianum* Rifai strain T-22 colony forming unit per gram dry weight; and
  - 5.3 million *Trichoderma virens* strain G-41 colony forming unit per gram dry weight

  and is registered for control of *Phytophthora* which is the genus that causes leather rot of strawberries.

RESISTANCE MANAGEMENT

The following text is from US EPA PR Notice 2017-1 regarding resistance management.

> *"What causes pesticide resistance; how does it happen?*
> *In general, pesticide resistance occurs when genetic or behavioral changes enable pest individuals to tolerate or survive what would otherwise be lethal doses of a pesticide and then spread those changes through the larger pest population. These changes are usually biochemical in nature (e.g., genes allowing metabolic detoxification of a pesticide occur as a result of random mutation, and these in turn allow pest individuals to survive repeated and/or lower dose applications of a given pesticide). If a pesticide is not rotated with other chemicals with different modes of action over several applications, and/or if that pesticide is not used at a dose that is lethal enough to kill almost all of the pest population, then the genes responsible for the resistant trait can spread quickly through the population (i.e., pesticide susceptible individuals are killed off, but resistant ones that are not challenged by pesticides with different modes of action can then mate with one another and make the resistance trait more common over time)."*
>
> *Generally, how common / widespread is pesticide resistance?*
> *Resistance appears to be generally increasing in the U.S. and worldwide. For example, globally the number of unique herbicide-resistant weed species has risen from one in 1957 to over 440 in 2014 (www.weedscience.org). Between 1908 and 2012, the number of insecticide-resistant arthropod species has risen from one to 574 (www.pesticideresistance.org). Interested readers can find a list of resistant plant pathogens (as well as several other documents relevant to fungicide resistance) at http://www.frac.info/publications/downloads. This is a website maintained by the Fungicide Resistance Action Committee (FRAC). For insecticides (both within the U.S. and globally), there is a publicly available, searchable database of refereed publications that report*
> *resistance at http://www.pesticideresistance.org/index.php (maintained by Michigan State University). While the genetics of any individual pest population plays a role, a major human factor that fosters resistance development is a lack of understanding of resistance-management options available to crop producers who use pesticides routinely.*
>
> *What are the concepts that guide resistance-management strategies?*
> *EPA supports broader efforts at developing comprehensive resistance-management strategic plans that may take into account local conditions, soil management, crop rotation, cultural approaches and other factors. Resistance-management labeling will provide pesticide users with easy access to important information regarding target-site resistance, the cornerstone of most resistance-management programs. Development of pesticide resistance is influenced by a number of factors. One important factor that fosters pesticide resistance is the repeated use of pesticides with the same mode of action on the same pest population. Thus, an important proactive pesticide resistance-management strategy is to rotate pesticides with different modes of action to control target pests in any given location. This approach may delay the development of one important type of resistance, target site resistance, without resorting to increased rates and frequency of application, and may prolong the useful life of pesticides.*
>
> *If pesticides are used in a manner that facilitates the development and/or spread of resistance in target pest populations, pesticide users are likely to increase their use of multiple pesticides in attempts to manage pests that are becoming less susceptible to each pesticide application. This in turn would increase loading of pesticides in the environment, with the potential for unintended consequences such as increased impacts on non-target wildlife and increased exposure to humans. Without appropriate actions to manage*

resistance evolution, target pests would eventually show widespread resistance that no management tactic could adequately address, thus leading to potentially significant crop losses. Pesticide users look to product labeling as a primary source for their use instructions, and resistance-management guidance on labeling could significantly and immediately assist users to avoid or delay the spread of resistance in pests.

The agency has found pesticide resistance to be an adverse effect in that it can increase pesticide use and create unnecessary economic losses. The lack of appropriate resistance-management guidance on labeling may become a factor that could strongly influence EPA's regulatory conclusions on the risks and benefits of a pesticide."

Polyoxin D zinc salt has a unique, non-toxic mode of action. No other active ingredient registered for use in North America has the same mode of action (FRAC Code 19). Polyoxin D zinc salt can play an important role in resistance management programs. Polyoxin D zinc salt, if accepted by the National Organic Program, will be a new resistance management tool for organic growers.

UPDATED JUSTIFICATION FOR APPROVAL UNDER §205.601

The information below expands upon and clarifies information in the September 12, 2012 NOP Technical Report for polyoxin D zinc salt.

IDENTIFICATION OF THE PETITIONED SUBSTANCE

Active Ingredient

The petitioned substance is *limited* to polyoxin D zinc salt which is a 1:1 complex of polyoxin D and zinc. The CAS number for polyoxin D zinc salt is 146659-78-1.

Fourteen polyoxins have been identified and have been designated polyoxin A through polyoxin N. Polyoxin A through polyoxin N each have a *different* chemical structure. The petitioned substance does *not* include all polyoxins. Specifically, the petitioned substance does *not* include:

- Polyoxin A through C;
- Polyoxin E though N;
- Polyoxin A through C in combination with zinc; and/or
- Polyoxin E though N in combination with zinc.

The properties of polyoxins vary with the chemical structures. Kaken Pharmaceutical Co., Ltd. markets Polyoxin Complex in Asia. Polyoxin Complex contains multiple polyoxins and has significantly different efficacy compared to polyoxin D zinc salt.

Formulation

The 5% suspension concentrate formulation of polyoxin D zinc salt is the *only* formulation proposed for use in organic agriculture. The inert ingredients have been specifically selected for use in organic formations. The 5% suspension concentrate is registered by Kaken as Veggieturbo 5SC Suspension Concentrate Fungicide (EPA Reg. No. 67183-4) and is marketed in the United States by Certis USA L.L.C. as Oso 5%SC Fungicide (EPA Reg. No. 67183-4-70051).

Please note that the 11.3% water dispersible granular (WDG) formulation is *not* proposed for use in organic agriculture. The 11.3% WDG formulation has inert ingredients that are *not* compatible with organic agriculture.

CHARACTERIZATION OF THE PETITIONED SUBSTANCE

Polyoxin D zinc salt is used exclusively for the protection of plants against sensitive fungal plant pathogens.

Neither polyoxin D nor polyoxin D zinc salt are antibiotics. Polyoxin D and polyoxin D zinc salt have never been used or proposed for use as pharmaceuticals for use in human or veterinary medicine. Based upon screening data, polyoxin D has *no commercially viable efficacy* against tested common human or veterinary pathogens (bacteria, fungi, and yeast).

STATUS

US EPA Label: Use on Growing Crops

The most recent VEGGIETURBO 5SC Suspension Concentrate Fungicide label was stamped “Accepted” by the US EPA on January 3, 2018. Please see Appendix 1. Please note that the directions for use have been restructured so that they are in crop group number order instead of alphabetical order.

US EPA Label: Post-Harvest Use

The US EPA has issued a registration for Polyoxin D Zinc Salt 5-SC Post-Harvest (EPA Reg. No. 68173-5) for post-harvest use on pome fruits, pomegranates, and stone fruits. However, the product launch has been delayed for the development of large scale efficacy trial data to confirm and/or refine the directions for use.

Residue Authorizations

The US EPA has established a tolerance exemption for residues of polyoxin D zinc salt for all crops (pre-harvest and post-harvest) treated according to good agricultural practice (40 CFR §180.1285).

Crops grown in the United States and treated with polyoxin D zinc salt according to the US EPA registered label may be exported to:

- Canada;
- Mexico;
- New Zealand;
- South Korea; and
- Taiwan.

These countries have enacted regulations that are similar to EPA's tolerance exemption. Numerical maximum residue limits (MRLs) have not been established.

Kaken is pursuing additional imported crop authorizations for polyoxin D zinc salt that are similar to the US EPA's tolerance exemption. Applications to permit importation of crop commodities treated with polyoxin D zinc salt are pending or in preparation. The list of pending applications include the European Union.

No CODEX MRL has been proposed or accepted. The CODEX system does *not* have a provision for the concept of an MRL exemption. Only numerical MRLs may be established in the CODEX system.

International Authorizations for Use in Organic Agriculture

No application for international authorization for use in organic agriculture has been approved or is pending.

Polyoxin D zinc salt was first registered for use in Canada during 2017. During 2018, Engage Agro will be launching sales of the polyoxin D zinc salt 5SC formulation in Canada under the Diplomat brand name. Kaken will be investigating opportunities for organic use in Canada.

EVALUATION QUESTIONS FOR SUBSTANCES TO BE USED IN ORGANIC CROP PRODUCTION

1. What category of OFPA does this substance fall under?

Polyoxin D zinc salt is proposed as a substance described in 7 USC 6517 (c)(1)(B)(i) as "a toxin derived from bacteria."

Kaken Pharmaceutical Co., Ltd. (Kaken) proposes to *amend 7 CFR §205.601(i) to add polyoxin D zinc salt* as a synthetic substance allowed for use in organic crop production as plant disease control. ^^

2. Describe the most prevalent process used to manufacture or formulate the petitioned substance.

Active Ingredient Production

Polyoxin D is produced via a fermentation process using a naturally occurring, non-GMO microorganism. Polyoxin D is a naturally occurring substance.

Polyoxin D is highly water soluble. To reduce its water solubility, polyoxin D is converted to polyoxin D zinc salt using a very simple chemical reaction.

Kaken purchases and does not control the production process for the starting material containing zinc that is used to convert polyoxin D to polyoxin D zinc. Therefore, Kaken cannot assert that the zinc source is derived from native mined zinc (or from recycled zinc). Nonetheless, Kaken can confirm that detailed chemical analyses of multiple routine production batches of Polyoxin D Zinc Salt Technical confirm that no toxicologically significant heavy metals are present at or above the level of detection.

Polyoxin D zinc salt has been classified as a synthetic substance. During the spring 2013 public hearing, Dr. Davis, a former chair of the NOSB Crops Subcommittee, described polyoxin D zinc salt as a "naturally derived fermentation product with a twist."

5SC Formulation Production

The polyoxin D zinc salt 5SC formulation is produced via a blending process in which Polyoxin D Zinc Salt Technical is blended with inert ingredients that are each approved for use in organic agriculture. No chemical reactions occur via the formulation process.

3. Is the substance synthetic? Discuss whether the petitioned substance is formulated or manufactured by a chemical process, or created by a naturally occurring biological process.

During its April 2013 public hearing, the National Organic Standards Board classified polyoxin D zinc salt as a synthetic substance. Please see the answer to question 2 above for addition information.

4. Describe the persistence or concentration of the petitioned substance and/or its by-products in the environment.

As noted in the September 23, 2012 Technical Report, "Data reviewed by the EPA indicate that polyoxin D zinc salt degrades within 2-3 days of application, with a low toxicity profile [73 FR 69559]."

Neither polyoxin D zinc salt nor its by-products will persist or concentrate in the environment.

5. Describe the toxicity and mode of action of the substance and its breakdown products and any contaminants. Describe the persistence and areas of concentration in the environment of the substance and its breakdown products.

Timeline	
1997/08/20	US EPA issued the first registration of Polyoxin D Zinc Salt Technical.
2012/09/12	US EPA issued the tolerance exemption of all crops. Additional mammalian toxicology and environmental degradation data on TGAI were accepted by EPA.
2012/09/23	NOP Technical Evaluation Report for polyoxin D zinc salt is issued.
2012/09/27	US EPA issued the first registration of Veggieturbo 5SC Suspension Concentrate Fungicide.

The Technical Evaluation Report for Polyoxin D zinc salt was issued 4 days *before* Veggieturbo 5SC Suspension Concentrate Fungicide was first registered by the US EPA and did *not* consider data summaries included in the petition regarding Polyoxin D Zinc Salt 5SC Fungicide (EPA Reg. No. 67183-4).

Toxicity of Polyoxin D Zinc Salt Technical

Toxicity data submitted to and accepted by the US EPA and previously summarized for NOP but *not* included in the September 23, 2012 Technical Report for polyoxin D zinc salt are summarized below.

Assay	Polyoxin D Zinc Salt Technical		
	US EPA Comment	Meaning	Ref.
Developmental Toxicity (Teratology) (rabbit)	Maternal NOEL > 800 mg/kg/day. Pup NOEL > 800 mg/kg/day.	Does not cause birth defects in rabbits.	BRAD.
Developmental Toxicity (Teratology) (rat)	NOAEL > 1000 mg/kg/day.	Does not cause birth defects in rats.	EPA Review 05/11/2012.
Mutagenicity (*in vivo* mouse micronucleus test)	No mutagenic effects. No chromosomal mutations. No systemic toxicity. *In vitro* effects seen in earlier studies could *not* be replicated in the *in vivo* (whole animal) test.	Definitive study. Does not cause generic damage.	EPA Review 05/11/2012.
Two-Generation Reproduction	No reproductive effects at the limit dose.	Does not adversely effect reproduction.	EPA Review 05/11/2012.
Immunotoxicity (mouse)	Low immunotoxicity.	Does not adversely effect the immune system.	EPA Review 05/11/2012.
BRAD = US Environmental Protection Agency Office of Pesticide Programs Biopesticide Registration Action Document: Polyoxin D Zinc Salt (1997).			

The US EPA stated on pages 56131-56132 of the September 12, 2012 Federal Register,

> "Relevant data and information submitted for the previous tolerance exemption (73 FR 69560) and for this expansion of the tolerance exemption indicate that polyoxin D zinc salt has negligible acute, subchronic, chronic, and developmental toxicity. Moreover, polyoxin D zinc salt is defined by its fungistatic non-toxic mode of action, and demonstrates no significant mammalian effect. Therefore, the Agency concludes that there is a reasonable certainty that no harm will result to the U.S. population, including infants and children, from aggregate exposure to the residues of polyoxin D zinc salt. This includes all anticipated dietary exposures and all other exposures for which there is reliable information. EPA has arrived at this conclusion because *the data and information available on polyoxin D zinc salt do not demonstrate toxic potential to mammals.* Thus, there are no threshold effects of concern and, as a result, an additional margin of safety is not necessary." (Emphasis added.)

Toxicity of Veggieturbo 5SC Suspension Concentrate Fungicide

Assay	Veggieturbo 5SC Suspension Concentrate Fungicide		
	End-Point	EPA Category/ Description	Ref.
Acute oral (rats)	LD_{50} > 5000 mg/kg (females)	IV: Practically non-toxic.	EPA Review 09/07/2012.
Acute dermal (rats)	LD_{50} > 5050 mg/kg (males, females, and combined)	IV: Practically non-toxic.	EPA Review 09/07/2012.
Acute inhalation (rats; 4 hour)	LC_{50} > 2.20 mg/L (males, females, and combined)	IV: Practically non-toxic.	EPA Review 09/07/2012.
Primary eye irritation (rabbits)	Maximum average score was 4 one hour after test material installation. No irritation in any eyes at 24 hours after treatment.	IV: Practically non-toxic.	EPA Review 09/07/2012.
Primary dermal irritation (rabbits)	The primary index was 0.3 at 72 hours. Product is slightly irritating.	IV: Practically non-toxic.	EPA Review 09/07/2012.
Dermal sensitization (Guinea pigs)	The test substance produced very faint to faint erythema in 15 to 20 test animals, but no reaction in any Naive control animals after treatment.	No applicable EPA toxicity category. Label statement: Mild dermal sensitizer.	EPA Review 09/07/2012.

The acute toxicity of Veggieturbo 5SC Suspension Concentrate Fungicide is so low (all Category IV) that the US EPA does not require a first aid statement for Veggieturbo 5SC Suspension Concentrate Fungicide.

Mode of Action

Worldwide, polyoxin D zinc salt is produced and registered exclusively by Kaken Pharmaceutical Co., Ltd. (Kaken). This does *not* make Polyoxin D zinc salt an antibiotic. Polyoxin D and polyoxin D zinc salt are *not* antibiotics. They have *never* been marketed for use as pharmaceuticals for use in human medicine or in veterinary medicine. Based upon screening data, polyoxin D has *no commercially viable efficacy* against tested common human or veterinary pathogens (bacteria, fungi, and yeast).

6. Describe any environmental contamination that would result from the petitioned substance's manufacture, use, misuse, or disposal.

Veggieturbo 5SC Suspension Concentrate Fungicide (EPA Reg. No. 68173-4) and Oso 5%SC Fungicide (EPA Reg. No. 68173-4-70051) are both registered for terrestrial use only on crops. Intentional misuse involving direct application to water could harm fish and aquatic invertebrates. Risk to fish and aquatic invertebrates from registered uses is low due to the low application rates and rapid environmental degradation.

7. Describe any known chemical interactions between the petitioned substance and other substances used in organic crop production. Describe any environmental or human health effects from these chemical interactions.

Actinovate, Regalia and NovaSource's Lime-Sulfur

In Trial No. KAK-2016-Blueberry-WA-Org, the following products, used alone, each provided control of mummyberry fruit infections (fruit strikes) on blueberries that was better than the untreated control:

- Actinovate (containing *Streptomyces lydicus* WYEC 108; no FRAC Code; biological);
- Regalia (containing *Reynoutria sachalinensis* extract; FRAC Code P5), and
- NovaSource's Lime-Sulfur (containing calcium polysulfide; FRAC Code M2).

Oso enhanced the performance of Actinovate, Regalia, and NovaSource's Lime-Sulfur in the treatment of blueberries for control of mummyberry.

When Oso was used in combination with:

- Actinovate, better control of blueberry/ mummyberry fruit strikes (46.0 % control) was achieved than when Actinovate was used alone (13.3% control).
- Regalia, better control of blueberry/ mummyberry fruit strikes (42.7% control) was achieved than when Regalia was used alone (13.3% control).
- Regalia and Actinovate, better control of blueberry/ mummyberry fruit strikes (27.1% control) was achieved than when Regalia was used alone (13.3% control) and when Actinovate was used alone (also 13.3% control).
- NovaSource's Lime-Sulfur, better control of blueberry/mummyberry fruit strikes (34.9% control) was achieved than when NovaSource's Lime-Sulfur was used alone (20.0% control).

Double Nickel (containing *Bacillus amyloliquefaciens* str 747)
In Trial No. CER-2014-064, yellow crook neck squash plants were treated using three different treatment patterns:

- Eight Double Nickel applications at 7-day intervals;
- Four Double Nickel applications at 14-day intervals; and
- Eight applications total at 7-day intervals, with Double Nickel applied first and then alternated with Oso for the balance of the treatment program.

The largest yield increases relative to the untreated control were obtained when Double Nickle applications were alternated with Oso applications (132.0% increase for harvest 1 and 36.7% increase for harvest 2).

Therefore, Oso enhanced the performance of Double Nickel in the treatment of squash for control of powdery mildew.

Trichoderma (Bio-Tam and RootShield)
Polyoxin D zinc salt stops the growth of sensitive fungi. Therefore, Kaken does not recommend the use of polyoxin D zinc salt as a tank-mix partner or as part of the treatment program with products containing *Trichoderma* species [(Bio-Tam (EPA Reg. No. 80289-9), Rootshield Plus WP (EPA Reg. No. 68539-9) and Rootshield Plus Granules (EPA Reg. No. 68539-10)].

8. Describe any effects of the petitioned substance on biological or chemical interactions in the agro-ecosystem, including physiological effects on soil organisms, and crops.

Veggieturbo 5SC Suspension Concentrate Fungicide and Oso 5%SC Fungicide are each registered for foliar application to treatment of the above ground plant parts. Neither product is registered for application to the soil.

A special study described in the May 31, 2016 petition was conducted specifically for NOP and determined that the polyoxin D zinc salt 5SC formulation does *not* adversely effects beneficial soil organisms, including beneficial soil fungi.

In addition, polyoxin D zinc salt has been determined to not adversely effect earth worms. These data are also summarized in the May 31, 2016 petition.

9. Discuss and summarize findings on whether the petitioned substance may be harmful to the environment.

Please see the Kaken's above responses to items 4, 5, and 6.

- Neither polyoxin D zinc salt nor its by-products will persist or concentrate in the environment.
- The data and information available on polyoxin D zinc salt do not demonstrate toxic potential to mammals.
- The acute toxicity of Veggieturbo 5SC Suspension Concentrate Fungicide is so low (all Category IV) that the US EPA does not require a first aid statement for Veggieturbo 5SC Suspension Concentrate Fungicide.
- Polyoxin D and polyoxin D zinc salt are *not* antibiotics. They have *never* been marketed for use as pharmaceuticals for use in human medicine or in veterinary medicine.
- Veggieturbo 5SC Suspension Concentrate Fungicide (EPA Reg. No. 68173-4) and Oso 5%SC Fungicide (EPA Reg. No. 68173-4-70051) are both registered for terrestrial use only on crops. Intentional misuse involving direct application to water could harm fish and aquatic invertebrates. Risk to fish and aquatic invertebrates from registered uses is low due to the low application rates and rapid environmental degradation.

In addition, polyoxin D zinc salt does *not* adversely effect honey bees, ladybird beetles, or other beneficial insects.

10. Describe and summarize any reported effects on human health from use of the petitioned substance.

Kaken is not aware of any reported adverse effects on human health resulting from the use of polyoxin zinc D zinc salt or any of its formulations.

11. Describe all natural (non-synthetic) substances or products which may be used in place of a petitioned substance. Provide a list of allowed substances that may be used in place of the petitioned substance.

A list and brief description of the non-synthetic and synthetic products that may be used in place of the petitioned substance for use on Crop Group 13 and Crop Group 19 is provided below. For more detailed descriptions, please see the Evaluation of Organic Grower Needs, Step 2, Identification of OMRI-List Alternative Products, Efficacy Data, Product Hazards, and Restrictions beginning on page 127 of this addendum.

Please note that none on the listed alternatives have the same mode of action as polyoxin D zinc salt. As such, none of the listed alternatives is a true replacement for polyoxin D zinc salt. Instead, the listed products are EPA registered for the same crop/disease combination and are OMRI-listed.

US EPA Registered OMRI-Listed Alternatives [1] to Veggieturbo 5SC Suspension Concentrate Fungicide (EPA Reg. No. 68173-4) and Oso 5%SC Fungicide (EPA Reg. No. 68173-4-70051)				
NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.
Crop Group 13: Berries and Small Fruits: Blueberries / Alternaria Fruit Rot (*Alternaria* spp.)				
Non-synthetic	44	*Bacillus amyloliquefaciens* strain MBI 600	Serifel	71840-18
Non-synthetic	44	*Bacillus pumilus* strain QST 2808	Sonata	264-1153
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Optiva	264-1160
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade ASO	264-1152
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade Max	264-1151
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade Optimum	264-1160
Non-synthetic	P5	*Reynoutria sachalinensis* extract	Regalia	84059-3
Non-synthetic	NC; Biological	*Streptomyces lydicus* WYEC 108	Actinovate AG	73314-1
Non-synthetic	NC; Botanical oil	Neem oil	Trilogy	70051-2
Synthetic	NC; Oxidizing agent	Hydrogen dioxide, Peroxyacetic acid	Oxidate 2.0	70299-2
Crop Group 13: Berries and Small Fruits: Blueberries / Botrytis Blight (*Botrytis cinerea*)				
Non-synthetic	44	*Bacillus amyloliquefaciens* strain D747	Double Nickel 55	70051-108
Non-synthetic	44	*Bacillus amyloliquefaciens* strain D747	Double Nickel LC	70051-114
Non-synthetic	44	*Bacillus amyloliquefaciens* strain F727	Stargus	84059-28
Non-synthetic	44	*Bacillus amyloliquefaciens* strain MBI 600	Serifel	71840-18
Non-synthetic	44	*Bacillus pumilus* strain QST 2808	Sonata	264-1153
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Optiva	264-1160
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade ASO	264-1152
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade Max	264-1151
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade Optimum	264-1160
Non-synthetic	P5	*Reynoutria sachalinensis* extract	Regalia	84059-3
Non-synthetic	NC; Biological	*Aureobasidoium pullulans* strains DSM 14940 and DSM 19941	Botector	86174-3
Non-synthetic	NC; Biological	*Streptomyces lydicus* WYEC 108	Actinovate AG	73314-1
Non-synthetic	NC; Botanical oil	Neem oil	Trilogy	70051-2
Non-synthetic	NC; Botanical oil	Rosemary oil, Clove oil, Thyme oil	Sporatec	NA; 25(b)
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Agricure	70870-1
Synthetic	NC; Inorganic salt	Potassium bicarbonate	EcoMate Armicarb O	5905-541
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Milstop	70870-1-68539
Synthetic	NC; Inorganic salt	Potassium silicate	Sil-Matrix	82100-1
Synthetic	NC; Oxidizing agent	Hydrogen dioxide, Peroxyacetic acid	Oxidate 2.0	70299-2
Synthetic	NC; Oxidizing agent	Hydrogen peroxide, Hydrogen dioxide	Perpose Plus	86729-1
Crop Group 13: Berries and Small Fruits: Blueberries / Mummyberry (*Monilinia vaccinii-corymbosi*)				
Non-synthetic	44	*Bacillus amyloliquefaciens* strain D747	Double Nickel 55	70051-108
Non-synthetic	44	*Bacillus amyloliquefaciens* strain D747	Double Nickel LC	70051-114
Non-synthetic	44	*Bacillus amyloliquefaciens* strain MBI 600	Serifel	71840-18
Non-synthetic	44	*Bacillus pumilus* strain QST 2808	Sonata ASO	264-1153
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Optiva	264-1160
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade ASO	264-1152
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade Max	264-1151
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade Optimum	264-1160
Non-synthetic	P5	*Reynoutria sachalinensis* extract	Regalia	84059-3
Non-synthetic	NC; Biological	*Streptomyces lydicus* WYEC 108	Actinovate AG	73314-1
Non-synthetic	NC; Botanical oil	Clove oil, Rosemary oil, Peppermint oil	BacStop	NA; 25(b)
Synthetic	NC; Inorganic salt	Potassium bicarbonate	EcoMate Armicarb O	5905-541
Synthetic	NC; Oxidizing agent	Hydrogen dioxide, Peroxyacetic acid	Oxidate 2.0	70299-2

US EPA Registered OMRI-Listed Alternatives [1] to Veggieturbo 5SC Suspension Concentrate Fungicide (EPA Reg. No. 68173-4) and Oso 5%SC Fungicide (EPA Reg. No. 68173-4-70051)				
NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.
Crop Group 13: Berries and Small Fruits: Caneberries / Botrytis Fruit Rot (*Botrytis cinerea*)				
Non-synthetic	44	Bacillus amyloliquefaciens strain D747	Double Nickel 55	70051-108
Non-synthetic	44	*Bacillus amyloliquefaciens* strain MBI 600	Serifel	71840-18
Non-synthetic	44	*Bacillus pumilus* strain QST 2808	Sonata	264-1153
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade ASO	264-1152
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade Max	264-1151
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade Optimum	264-1160
Non-synthetic	P5	*Reynoutria sachalinensis* extract	Regalia	84059-3
Non-synthetic	NC; Biochemical	Rhamnolipid biosurfactant	Zonix	72431-1
Non-synthetic	NC; Biological	*Aureobasidium pullulans* strains DSM 14940 and DSM 14941	Botector	86174-3
Non-synthetic	NC; Biological	*Streptomyces lydicus* WYEC 108	Actinovate AG	73314-1
Non-synthetic	NC; Botanical oil	Neem oil	Trilogy	70051-2
Non-synthetic	NC; Botanical oil	Rosemary oil, Clove oil, Thyme oil	Sporatec	NA; 25(b)
Synthetic	M1	Copper octanoate	Cueva	67702-2-70051
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Agricure	70870-1
Synthetic	NC; Inorganic salt	Potassium bicarbonate	EcoMate Armicarb O	5905-541
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Milstop	70870-1-68539
Synthetic	NC; Oxidizing agent	Hydrogen dioxide, Peroxyacetic acid	Oxidate 2.0	70299-2
Crop Group 13: Berries and Small Fruits: Caneberries / Powdery Mildew (*Podosphaera aphanis*)				
Non-synthetic	44	*Bacillus amyloliquefaciens* strain MBI 600	Serifel	71840-18
Non-synthetic	44	*Bacillus pumilis* strain QST 2808	Sonata ASO	264-1153
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade Max	264-1151
Non-synthetic	P5	*Reynoutria sachalinensis* extract	Regalia	84059-3
Non-synthetic	NC; Biochemical	Rhamnolipid biosurfactant	Zonix	72431-1
Non-synthetic	NC; Biological	*Streptomyces lydicus* WYEC	Actinovate	73314-1
Non-synthetic	NC; Botanical oil	Neem oil	Trilogy	70051-2
Non-synthetic	NC; Botanical oil	Cinnamon oil	Cinnerate	NA; 25(b)
Non-synthetic	NC; Botanical oil	Garlic oil, Cottonseed oil, Corn oil	Mildew Cure	NA; 25(b)
Non-synthetic	NC; Botanical oil	Rosemary oil, Clove oil, Thyme oil	Sporatec	NA; 25(b)
Non-synthetic	NC; Organic acid	Citric acid	Nuke Em	NA; 25(b)
Synthetic	M2	Sulfur	Acoidal	62562-4
Synthetic	M2	Sulfur	Cosavet-DF	70905-1
Synthetic	M2	Sulfur	Defend DF	62562-8
Synthetic	M2	Sulfur	Kumulus DF	51306-352-66330
Synthetic	M2	Sulfur	Micro Sulf	55146-75
Synthetic	M2	Sulfur	Microthiol Disperss	70506-187
Synthetic	M2	Sulfur	Thiolux	34704-1079
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Agricure	70870-1
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Kaligreen	70231-1
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Milstop	70870-1-68539
Synthetic	NC; Inorganic salt	Potassium bicarbonate	EcoMate Armicarb O	5905-541
Synthetic	NC; Inorganic salt	Potassium silicate	Sil-Matrix	82100-1
Synthetic	NC; Organic salt	Potassium salts of fatty acids	M-Pede	10163-324
Synthetic	NC; Organic salt	Insecticidal soap	Des-X	67702-22-70051
Synthetic	NC; Oxidizing agent	Hydrogen dioxide, Peroxyacetic acid	Oxidate	70299-2
Synthetic	NC; Oxidizing agent	Hydrogen peroxide, Hydrogen dioxide	Perpose Plus	86729-1

US EPA Registered OMRI-Listed Alternatives [1] to Veggieturbo 5SC Suspension Concentrate Fungicide (EPA Reg. No. 68173-4) and Oso 5%SC Fungicide (EPA Reg. No. 68173-4-70051)				
NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.
Synthetic	NC; Petroleum oil	Mineral oil	Glacial Spray Liquid	34704-849
Synthetic	NC; Petroleum oil	Mineral oil	JMS Stylet Oil	65564-1
Synthetic	NC; Petroleum oil	Mineral oil	Omni Supreme Spray	5905-368
Synthetic	NC; Petroleum oil	Mineral oil	PureSpray Green	69526-9
Synthetic	NC; Petroleum oil	Mineral oil	TriTek	48813-1
Synthetic	NC; Petroleum oil	Aliphatic petroleum solvent	SuffOil-X	48813-1-68539
Crop Group 13: Berries and Small Fruits: Cranberries / Cottonball (*Monilinia oxycocci*)				
No alternatives				
Crop Group 13: Berries and Small Fruits: Cranberries / Fruit Rot Complex (*Coleophoma empetri*, *Colletotrichum acutatum*, *Colletotrichum gloeosporioides*, *Phyllosticta vaccinii*, and *Physalospora vaccinii*, etc.)				
Synthetic	M1	Copper hydroxide	Nu-Cop 50 WP	42002-7
Synthetic	M1	Copper hydroxide	Champ WG	55146-1
Synthetic	M1	Copper hydroxide, Copper oxychloride	Badge X2	80289-12
Synthetic	M1	Copper sulfate pentahydrate	CS 2005	66675-3
Synthetic	M1	Cupric hydroxide	Nu-Cup HB	42750-132
Synthetic	M1	Cuprous oxide	Nordox 75 WG	48142-4
Crop Group 13: Berries and Small Fruits: Grapes / Black Rot (*Guignardia bidwellii*)				
Non-synthetic	44	*Bacillus amyloliquefaciens* strain F727	Stargus	84059-28
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade Max	264-1151
Non-Synthetic	P5	*Reynoutria sachalinensis* extract	Regalia	84059-3
Non-synthetic	NC; Botanical oil	Rosemary oil, Clove oil, Thyme oil	Sporatec	NA; 25(b)
Synthetic	M1	Basic copper sulfate	Basic Copper 53	45002-8
Synthetic	M1	Copper oxychloride, Copper hydroxide	Badge X2	50289-12
Synthetic	M1	Copper hydroxide	Champ WG	55146-1
Synthetic	M1	Copper hydroxide	Nu-Cop 50 WP	42002-7
Synthetic	M1	Copper octanoate	Cueva	67702-2-70051
Synthetic	M1	Copper sulfate pentahydrate	CS 2005	66675-3
Synthetic	M1	Cupric hydroxide	NuCop 50 DF	45002-4
Synthetic	M1	Cupric hydroxide	Nu-Cop HB	42750-132
Synthetic	M1	Cuprous oxide	Nordox 75 WG	48142-4
Synthetic	NC; Oxidizing agent	Hydrogen dioxide, Peroxyacetic acid	Oxidate 2.0	70299-2
Crop Group 13: Berries and Small Fruits: Grapes / Bunch Rot (*Botrytis cinerea*)				
Non-synthetic	44	*Bacillus amyloliquefaciens* strain D747	Double Nickel 55	70051-108
Non-synthetic	44	*Bacillus amyloliquefaciens* strain D747	Double Nickel LC	70051-114
Non-synthetic	44	*Bacillus amyloliquefaciens* strain F727	Stargus	84059-28
Non-synthetic	44	*Bacillus amyloliquefaciens* strain MBI 600	Serifel	71840-18
Non-synthetic	44	*Bacillus pumilus* strain QST 2808	Sonata	264-1153
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Optiva	264-1160
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade ASO	264-1152
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade Max	264-1151
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade Optimum	264-1160
Non-synthetic	P5	*Reynoutria sachalinensis* extract	Regalia	84059-3
Non-synthetic	NC; Biological	*Aureobasidium pullulans* strains DSM 14940 and DSM 14941	Botector	86174-3
Non-synthetic	NC; Biological	*Streptomyces lydicus*	Actinovate AG	73314-1
Non-synthetic	NC; Biological	*Ulacladium ouderansii* strain U3	Zen-O-Spore	75747-2

US EPA Registered OMRI-Listed Alternatives [1] to Veggieturbo 5SC Suspension Concentrate Fungicide (EPA Reg. No. 68173-4) and Oso 5%SC Fungicide (EPA Reg. No. 68173-4-70051)				
NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.
Non-synthetic	NC; Botanical oil	Neem oil	Trilogy	70051-2
Non-synthetic	NC; Botanical oil	Clove oil, Rosemary oil, Peppermint oil	BacStop	NA; 25(b)
Non-synthetic	NC; Botanical oil	Rosemary oil, Clove oil, Thyme oil	Sporatec	NA; 25(b)
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Agricure	70870-1
Synthetic	NC; Inorganic salt	Potassium bicarbonate	EcoMate Armicarb O	5905-541
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Milstop	70870-1-68539
Synthetic	NC; Oxidizing agent	Hydrogen dioxide, Peroxyacetic acid	Oxidate 2.0	70299-2
Synthetic	NC; Oxidizing agent	Hydrogen peroxide, Hydrogen dioxide	Perpose Plus	86729-1
Synthetic	NC; Petroleum oil	Mineral oil	JMS Stylet Oil	65564-1
Synthetic	NC; Petroleum oil	Mineral oil	PureSpray Green	69526-9
Synthetic	NC; Petroleum oil	Aliphatic petroleum solvent	SuffOil-X	48813-1-68539
Synthetic	NC; Petroleum oil	Mineral oil	TriTek	48813-1
Crop Group 13: Berries and Small Fruits: Grapes / Downy Mildew (*Plasmopara viticola*)				
Non-synthetic	44	*Bacillus amyloliquefaciens* strain D747	Double Nickel 55	70051-108
Non-synthetic	44	*Bacillus amyloliquefaciens* strain D747	Double Nickel LC	70051-114
Non-synthetic	44	*Bacillus amyloliquefaciens* strain F727	Stargus	84059-28
Non-synthetic	44	*Bacillus amyloliquefaciens* strain MBI 600	Serifel	71840-18
Non-synthetic	44	*Bacillus mycoides*, isolate J	LifeGard WG	70051-119
Non-synthetic	44	*Bacillus pumilus* strain QST 2808	Sonata	264-1153
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade ASO	264-1152
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade Max	264-1151
Non-synthetic	P5	*Reynoutria sachalinensis* extract	Regalia	84059-3
Non-synthetic	NC; Biological	*Streptomyces lydicus*	Actinovate AG	73314-1
Non-synthetic	NC; Botanical oil	Neem oil	Trilogy	70051-2
Non-synthetic	NC; Botanical oil	Rosemary oil, Clove oil, Thyme oil	Sporatec	NA; 25(b)
Synthetic	M1	Basic copper sulfate	Basic Copper 53	45002-8
Synthetic	M1	Copper oxychloride, Copper hydroxide	Badge X2	80289-12
Synthetic	M1	Copper hydroxide	Champ WG	55146-1
Synthetic	M1	Copper hydroxide	Nu-Cop 50 WP	42002-7
Synthetic	M1	Copper octanoate	Cueva	67702-2-70051
Synthetic	M1	Copper sulfate pentahydrate	CS 2005	66675-3
Synthetic	M1	Copper sulfate pentahydrate	Copper Sulfate Crystals	56576-1
Synthetic	M1	Copper sulfate pentahydrate	Quimag Quimicos Arguila Copper Sulfate Crystals	73385-3
Synthetic	M1	Cupric hydroxide	NuCop 50 DF	45002-4
Synthetic	M1	Cupric hydroxide	Nu-Cop HB	42750-132
Synthetic	M1	Cuprous oxide	Nordox 75 WG	48142-4
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Agricure	70870-1
Synthetic	NC; Inorganic salt	Potassium bicarbonate	EcoMate Armicarb O	5905-541
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Milstop	70870-1-68539
Synthetic	NC; Oxidizing agent	Hydrogen dioxide, Peroxyacetic acid	Oxidate 2.0	70299-2
Synthetic	NC; Oxidizing agent	Hydrogen peroxide, Hydrogen dioxide	Perpose Plus	86729-1

US EPA Registered OMRI-Listed Alternatives [1] to Veggieturbo 5SC Suspension Concentrate Fungicide (EPA Reg. No. 68173-4) and Oso 5%SC Fungicide (EPA Reg. No. 68173-4-70051)				
NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.
Crop Group 13: Berries and Small Fruits: Grapes / Phomopsis (*Phomopsis viticola*)				
Non-synthetic	44	*Bacillus amyloliquefaciens* strain D747	Double Nickel 55	70051-108
Non-synthetic	44	*Bacillus amyloliquefaciens* strain D747	Double Nickel LC	70051-114
Non-synthetic	44	*Bacillus amyloliquefaciens* strain F727	Stargus	84059-28
Non-synthetic	44	*Bacillus amyloliquefaciens* strain MBI 600	Serifel	71840-18
Non-synthetic	44	*Bacillus pumilus* strain QST 2808	Sonata	264-1153
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade ASO	264-1152
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade Max	264-1151
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Optiva	264-1160
Non-synthetic	P5	*Reynoutria sachalinensis* extract	Regalia	84059-3
Non-synthetic	NC; Botanical oil	Clove oil, Rosemary oil, Peppermint oil	BacStop	NA; 25(b)
Synthetic	M1	Copper oxychloride, Copper hydroxide	Badge X2	80289-12
Synthetic	M1	Copper hydroxide	Champ WG	55146-1
Synthetic	M1	Copper octanoate	Cueva	67702-2-70051
Synthetic	M1	Copper sulfate pentahydrate	CS 2005	66675-3
Synthetic	M1	Cupric hydroxide	Nu Cop 50 DF	45002-4
Synthetic	M1	Cupric hydroxide	Nu Cop HB	42750-132
Synthetic	M1	Cuprous oxide	Nordox	48142-4
Synthetic	M2	Sulfur	Acoidal	62562-4
Synthetic	M2	Sulfur	Defend DF	62562-8
Synthetic	M2	Sulfur	Kumulus DF	51306-352-66330
Synthetic	M2	Sulfur	Micro Sulf	55146-75
Synthetic	M2	Sulfur	Microthiol Disperss	70506-187
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Agricure	70870-1
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Milstop	70870-1-68539
Crop Group 13: Berries and Small Fruits: Grapes / Powdery Mildew (*Erisyphe necator*)				
Non-synthetic	44	*Bacillus amyloliquefaciens* strain D747	Double Nickel 55	70051-108
Non-synthetic	44	*Bacillus amyloliquefaciens* strain D747	Double Nickel LC	70051-114
Non-synthetic	44	*Bacillus amyloliquefaciens* strain F727	Stargus	84059-28
Non-synthetic	44	*Bacillus amyloliquefaciens* strain MBI 600	Serifel	71840-18
Non-synthetic	44	*Bacillus mycoides*, isolate J	LifeGard WG	70051-119
Non-synthetic	44	*Bacillus pumilus* strain QST 2808	Sonata	264-1153
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Optiva	264-1160
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade ASO	264-1152
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade Max	264-1151
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade Optimum	264-1160
Non-synthetic	P5	*Reynoutria sachalinensis* extract	Regalia	84059-3
Non-synthetic	NC; Biological	*Streptomyces lydicus* WYEC	Actinovate	73314-1
Non-synthetic	NC; Botanical oil	Cinnamon oil	Cinnerate	NA; 25(b)
Non-synthetic	NC; Botanical oil	Garlic oil, Cottonseed oil, Corn oil	Mildew Cure	NA; 25(b)
Non-synthetic	NC; Botanical oil	Rosemary oil, Clove oil, Thyme oil	Sporatec	NA; 25(b)
Non-synthetic	NC; Botanical oil	Neem oil	Trilogy	70051-2
Non-synthetic	NC; Botanical oil	Rosemary oil, Clove oil, Thyme oil	Sporatec	NA; 25(b)
Non-synthetic	NC; Organic acid	Citric acid	Nuke Em	NA; 25(b)

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NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.
Synthetic	M1	Copper hydroxide	Nu-Cop 50 WP	42002-7
Synthetic	M1	Copper hydroxide	Champ WG	55146-1
Synthetic	M1	Copper hydroxide	Nu-Cop HB	42750-132
Synthetic	M1	Copper hydroxide, Copper oxychloride	Badge X2	80289-12
Synthetic	M1	Copper octanoate	Cueva	67702-2-70051
Synthetic	M1	Copper sulfate pentahydrate	CS 2005	66675-3
Synthetic	M1	Copper sulfate pentahydrate	Copper Sulfate Crystals	56576-1
Synthetic	M1	Cupric hydroxide	Nu-Cop 50 DF	45002-4
Synthetic	M1	Cuprous oxide	Nordox	48142-4
Synthetic	M2	Sulfur	Acoidal	62562-4
Synthetic	M2	Sulfur	Cosavet-DF	70905-1
Synthetic	M2	Sulfur	Defend DF	62562-8
Synthetic	M2	Sulfur	Kumulus DF	51306-352-66330
Synthetic	M2	Sulfur	Micro Sulf	55146-75
Synthetic	M2	Sulfur	Microthiol Disperss	70506-187
Synthetic	M2	Sulfur	Thiolux	34704-1079
Synthetic	NC; Inorganic salt	Potassium bicarbonate	EcoMate Armicarb O	5905-541
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Kaligreen	70231-1
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Milstop	70871-1-68539
Synthetic	NC; Inorganic salt	Potassium silicate	Sil-Matrix	82100-1
Synthetic	NC; Organic salt	Potassium salts of fatty acids	M-Pede	10163-324
Synthetic	NC; Organic salt	Insecticidal soap	Des-X	67702-22-70051
Synthetic	NC; Oxidizing agent	Hydrogen dioxide, Peroxyacetic acid	Oxidate	70299-2
Synthetic	NC; Oxidizing agent	Hydrogen peroxide, Hydrogen dioxide	Perpose Plus	86729-1
Synthetic	NC; Petroleum oil	Mineral oil	Glacial Spray Liquid	34704-849
Synthetic	NC; Petroleum oil	Mineral oil	JMS Stylet Oil	65564-1
Synthetic	NC; Petroleum oil	Mineral oil	Omni Supreme Spray	5905-368
Synthetic	NC; Petroleum oil	Mineral oil	PureSpray Green	69526-9
Synthetic	NC; Petroleum oil	Mineral oil	SuffOil-X	48813-1-68539
Synthetic	NC; Petroleum oil	Mineral oil	TriTek	48813-1
Crop Group 13: Berries and Small Fruits: Strawberries / Anthracnose Fruit Rot (*Colletotrichum acutatum*)				
Non-synthetic	44	*Bacillus amyloliquefaciens* strain D747	Double Nickel 55	70051-108
Non-synthetic	44	*Bacillus amyloliquefaciens* strain D747	Double Nickel LC	70051-114
Non-synthetic	44	*Bacillus amyloliquefaciens* strain MBI 600	Serifel	71840-18
Non-synthetic	44	*Bacillus pumilus* strain QST 2808	Sonata	264-1153
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade ASO	264-1152
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade Optimum	264-1160
Non-synthetic	P5	*Reynoutria sachalinensis* extract	Regalia	84059-3
Non-synthetic	NC; Biological	*Aureobasidoium pullulans* strains DSM 14940 and DSM 19941	Botector	86174-3
Non-synthetic	NC; Biological	*Streptomyces lydicus* WYEC	Actinovate	73314-1
Non-synthetic	NC; Botanical oil	Rosemary oil, Clove oil, Thyme oil	Sporatec	NA; 25(b)

US EPA Registered OMRI-Listed Alternatives [1] to Veggieturbo 5SC Suspension Concentrate Fungicide (EPA Reg. No. 68173-4) and Oso 5%SC Fungicide (EPA Reg. No. 68173-4-70051)				
NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.
Synthetic	M1	Copper octanoate	Cueva	67702-25-70051
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Agricure	70870-1
Synthetic	NC; Inorganic salt	Potassium bicarbonate	EcoMate Armicarb O	5905-541
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Milstop	70870-1-68539
Synthetic	NC; Oxidizing agent	Hydrogen peroxide, Hydrogen dioxide	Perpose Plus	86729-1
Crop Group 13: Berries and Small Fruits: Strawberries / Gray Mold (*Botrytis cinerea*)				
Non-synthetic	44	*Bacillus amyloliquefaciens* strain D747	Double Nickel 55	70051-108
Non-synthetic	44	*Bacillus amyloliquefaciens* strain D747	Double Nickel LC	70051-114
Non-synthetic	44	*Bacillus amyloliquefaciens* strain F727	Stargus	84059-28
Non-synthetic	44	*Bacillus amyloliquefaciens* strain MBI 600	Serifel	71840-18
Non-synthetic	44	*Bacillus pumilus* strain QST 2808	Sonata	264-1153
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Optiva	264-1160
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade ASO	264-1152
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade Max	264-1151
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade Optimum	264-1160
Non-synthetic	P5	*Reynoutria sachalinensis* extract	Regalia	84059-3
Non-synthetic	NC; Biochemical	Rhamnolipid biosurfactant	Zonix	72431-1
Non-synthetic	NC; Biological	*Aureobasidoium pullulans* strains DSM 14940 and DSM 19941	Botector	86174-3
Non-synthetic	NC; Biological	*Gliocladium catenulatum*	Prestop	64137-11
Non-synthetic	NC; Biological	*Streptomyces lydicus* WYEC	Actinovate	73314-1
Non-synthetic	NC; Botanical oil	Cinnamon oil	Cinnerate	NA; 25(b)
Non-Synthetic	NC; Botanical oil	Clove oil, Rosemary oil, Peppermint oil	BacStop	NA; 25(b)
Non-synthetic	NC; Botanical oil	Rosemary oil, Clove oil, Thyme oil	Sporatec	NA; 25(b)
Non-synthetic	NC; Botanical oil	Neem oil	Trilogy	70051-2
Synthetic	M1	Copper octanoate	Cueva	67702-25-70051
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Agricure	70870-1
Synthetic	NC; Inorganic salt	Potassium bicarbonate	EcoMate Armicarb O	5905-541
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Milstop	70870-1-68539
Synthetic	NC; Oxidizing agent	Hydrogen dioxide, Peroxyacetic acid	Oxidate	70299-2
Synthetic	NC; Oxidizing agent	Hydrogen peroxide, Hydrogen dioxide	Perpose Plus	86729-1
Synthetic	NC; Petroleum oil	Mineral oil	JMS Stylet Oil	65564-1
Synthetic	NC; Petroleum oil	Mineral oil	PureSpray Green	69526-9
Crop Group 13: Berries and Small Fruits: Strawberries / Leather Rot (*Phytophthora cactorum*)				
Non-synthetic	BM2	*Trichoderma asperellum*, *Trichoderma gamsii*	Bio-Tam	80289-9
Non-synthetic	BM2	*Trichoderma harzianum* strain R-22, *Trichoderma virens* strain G41	Rootshield Plus+ Granules	68539-10
Non-synthetic	BM2	*Trichoderma harzianum* strain R-22, *Trichoderma virens* strain G41	Rootshield Plus+ WP	68539-9
Non-synthetic	NC; Biological	*Aureobasidium pullulans* strains DSM 14940 and DSM 14941	Botector	86174-3
Non-synthetic	NC; Biological	*Gliocladium catenulatum*	Prestop	64137-11

US EPA Registered OMRI-Listed Alternatives [1] to Veggieturbo 5SC Suspension Concentrate Fungicide (EPA Reg. No. 68173-4) and Oso 5%SC Fungicide (EPA Reg. No. 68173-4-70051)				
NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.
Crop Group 13: Berries and Small Fruits: Strawberries / Phomopsis Leaf Spot (Blight) (*Phomopsis obscurans*)				
Non-synthetic	P5	*Reynoutria sachalinensis* extract	Regalia	84059-3
Non-synthetic	NC; Biological	*Aureobasidoium pullulans* strains DSM 14940 and DSM 19941	Botector	86174-3
Synthetic	M1	Copper octanoate	Cueva	67702-2-70051
Synthetic	M1	Cupric hydroxide	Nu-Cop 50 DF	45002-4
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Agricure	70870-1
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Milstop	70870-1-68539
Crop Group 13: Berries and Small Fruits: Strawberries / Phomopsis Fruit Rot (*Phomopsis obscurans*)				
Non-synthetic	NC; Biological	*Aureobasidoium pullulans* strains DSM 14940 and DSM 19941	Botector	86174-3
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Agricure	70870-1
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Milstop	70870-1-68539
Crop Group 13: Berries and Small Fruits: Strawberries / Powdery Mildew (*Podosphaera aphanis*, *Sphacelotheca* sp.)				
Non-synthetic	44	*Bacillus amyloliquefaciens* strain D747	Double Nickel 55	70051-108
Non-synthetic	44	*Bacillus amyloliquefaciens* strain D747	Double Nickel LC	70051-114
Non-synthetic	44	*Bacillus amyloliquefaciens* strain MBI 600	Serifel	71840-18
Non-synthetic	44	*Bacillus pumilus* strain QST 2808	Sonata	264-1153
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade ASO	264-1152
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade Max	264-1151
Non-synthetic	44	*Bacillus subtilis* strain QST 713	Serenade Optimum	264-1160
Non-synthetic	NC; Biochemical	Rhamnolipid biosurfactant	Zonix	72431-1
Non-synthetic	NC; Biological	*Streptomyces lydicus* WYEC	Actinovate	73314-1
Non-synthetic	NC; Botanical oil	Neem oil	Trilogy	70051-2
Non-synthetic	NC; Botanical oil	Cinnamon oil	Cinnerate	NA; 25(b)
Non-synthetic	NC; Botanical oil	Garlic oil, Cottonseed oil, Corn oil	Mildew Cure	NA; 25(b)
Non-synthetic	NC; Botanical oil	Clove oil, Rosemary oil, Peppermint oil	BacStop	NA; 25(b)
Non-synthetic	NC; Botanical oil	Rosemary oil, Clove oil, Thyme oil	Sporatec	NA; 25(b)
Non-synthetic	NC; Botanical oil	Soybean oil	Golden Pest Spray	57538-11
Synthetic	M1	Copper octanoate	Cueva	67702-2-70051
Synthetic	M2	Sulfur	Acoidal	62562-4
Synthetic	M2	Sulfur	Cosavet-DF	70905-1
Synthetic	M2	Sulfur	Defend DF	62562-8
Synthetic	M2	Sulfur	Kumulus DF	51306-352-66330
Synthetic	M2	Sulfur	Micro Sulf	55146-75
Synthetic	M2	Sulfur	Microthiol Disperss	70506-187
Synthetic	M2	Sulfur	Thiolux	34704-1079
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Agricure	70870-1
Synthetic	NC; Inorganic salt	Potassium bicarbonate	EcoMate Armicarb O	5905-541
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Kaligreen	70231-1
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Milstop	70871-1-68539
Synthetic	NC; Inorganic salt	Potassium silicate	Sil-Matrix	82100-1
Synthetic	NC; Organic salt	Potassium salts of fatty acids	M-Pede	10163-324
Synthetic	NC; Organic salt	Insecticidal soap	Des-X	67702-22-70051
Synthetic	NC; Oxidizing agent	Hydrogen dioxide, Peroxyacetic acid	Oxidate	70299-2
Synthetic	NC; Oxidizing agent	Hydrogen peroxide, Hydrogen dioxide	Perpose Plus	86729-1

US EPA Registered OMRI-Listed Alternatives [1] to Veggieturbo 5SC Suspension Concentrate Fungicide (EPA Reg. No. 68173-4) and Oso 5%SC Fungicide (EPA Reg. No. 68173-4-70051)				
NOP Status	FRAC [A] Code(s)	Active Ingredient(s)	Product	EPA Reg. No.
Synthetic	NC; Petroleum oil	Mineral oil	Glacial Spray Liquid	34704-849
Synthetic	NC; Petroleum oil	Mineral oil	JMS Stylet Oil	65564-1
Synthetic	NC; Petroleum oil	Mineral oil	Omni Supreme Spray	5905-368
Synthetic	NC; Petroleum oil	Mineral oil	PureSpray Green	69526-9
Synthetic	NC; Petroleum oil	Mineral oil	SuffOil-X	48813-1-68539
Synthetic	NC; Petroleum oil	Mineral oil	TriTek	48813-1
Crop Group 19: Herbs and Spices : Basil / Downy Mildew (*Peronospora belbahrii*)				
Non-synthetic	44	*Bacillus amyloliquefaciens* strain D747	Double Nickel 55	70051-108
Non-synthetic	44	*Bacillus amyloliquefaciens* strain D747	Double Nickel LC	70051-114
Non-synthetic	P5	*Reynoutria sachalinensis* extract	Regalia	84059-3
Non-synthetic	NC; Biological	*Streptomyces lydicus* WYEC	Actinovate	73314-1
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Agricure	70870-1
Synthetic	NC; Inorganic salt	Potassium bicarbonate	Milstop	70870-1-68539
Synthetic	NC; Oxidizing agent	Hydrogen dioxide, Peroxyacetic acid	Oxidate	70299-2

1. Botector (EPA Reg. No. 86174-3), based upon the January 5, 2018 EPA accepted label, is approved by NOP for use in organic production. No OMRI listing is noted. Nonetheless, Botector is included in the above table. Fracture (EPA Reg. No. 84876-1-279) is a biopesticide but is *not* currently OMRI-listed based upon information on the Internet.

For alternative products for other crop/disease combinations, please see the May 31, 2016 petition Overview of OMRI-Listed Alternatives section beginning on page 50.

Though the list of US EPA registered OMRI-listed alternatives is long, *the list of US EPA registered OMRI-listed alternatives with comparable or superior efficacy is short*.

Based upon *disease significance and efficacy data alone*, there is *organic grower need* for the polyoxin D zinc salt 5SC formulation (a.k.a. Oso) for treatment of:

- Blueberries for control of Alternaria blight (*Alternaria* spp.) and Botrytis blight (*Botrytis cinerea*);
- Caneberries for control of Botrytis fruit rot (*Botrytis cinerea*) and powdery mildew (*Podosphaera aphanais*);
- Cranberries for control of cottonball (Monilinia oxycocci) and fruit rot complex (*Coleophoma empetri*, *Colletotrichum acutatum*, *Colletotrichum gloeosporioides*, *Phyllosticta vaccinii*, and *Physalospora vaccinii*, etc.);
- Grapes for control of Phomopsis fruit rot (*Phomopsis viticola*);
- Strawberries for control of anthracnose fruit rot (*Colletotrichum acutatum*), gray mold (*Botrytis cinerea*), leather rot (*Phytophthora cactorum*), and Phomopsis fruit rot (soft rot) (*Phomopsis obscurans*); and
- Basil for control of downy mildew (*Peronospora belbahrii*).

OMRI-listed alternatives initially identified as having comparable or superior efficacy and therefore identified for more detailed comparisons were:

- Blueberries/mummyberry (*Monilinia vaccinii-corymbosi*): Optiva;
- Grapes black rot (*Guignardia bodwellii*): Badge X2 and Nu-Cop 50 WP;
- Grapes/bunch rot (*Botrytis cinerea*): Double Nickel 55 and Double Nickel LC;
- Grapes/downy mildew (*Plasmopara viticola*): Badge X2, Cueva, and Oxidate;
- Grapes/powdery mildew (*Erysiphe necator*): Micro Sulf, Lifegard WG and Stargus; and
- Strawberries/Phomopsis leaf spot (*Phomopsis obscurans*): Cueva.

Based upon ***efficacy data and other considerations***, there is ***organic grower need*** for the polyoxin D zinc salt 5SC formulation (a.k.a. Oso) for treatment of:

- Blueberries for control of mummyberry (*Monilinia vaccinii-corymbosi*). Compared to Optiva, the polyoxin D zinc salt 5SC formulation offers organic blueberry growers:
  - Competitive efficacy for control of mummyberry;
  - Competitive worker and environmental safety;
  - A treatment option ***after*** mummyberry is first observed;
  - A reduced risk product with a new non-toxic mode of action for use in resistance management and integrated pest management (IPM); and
  - Opportunities for export of the treated crop to Canada, Mexico, New Zealand, South Korea, Taiwan, and a growing list of additional countries.

- Grapes for the control of black rot (*Guignardia bodwellii*). Compared to Badge X2 and Nu-Cop 50 WP, the polyoxin D zinc salt 5SC formulation offers organic grape growers:
  - Competitive efficacy for control of black rot;
  - Greater crop, worker, and environmental safety;
  - An opportunity to reduce the amount of copper applied to their vineyards and thereby reduce the negative effects of copper on soil;
  - Reduced (EPA's minimum) personal protective equipment requirement;
  - Greater flexibility in growing the crop (0-day PHI instead of 1-day; 4-hour worker re-entry interval instead of 48-hours or 24-hours);
  - A reduced risk product with a new non-toxic mode of action for use in resistance management and integrated pest management (IPM); and
  - Opportunities for export of the treated crop to Canada, Mexico, New Zealand, South Korea, Taiwan, and a growing list of additional countries.

- Grapes for the control of bunch rot (*Botrytis cinerea*). Compared to Double Nickel 55 and Double Nickel LC, the polyoxin D zinc salt 5SC formulation offers organic grape growers:
  - Competitive or superior efficacy for control of bunch rot;
  - A treatment option ***after*** bunch rot is first observed;
  - Competitive worker and environmental safety;
  - A reduced risk product with a new non-toxic mode of action for use in resistance management and integrated pest management (IPM); and
  - Opportunities for export of the treated crop to Canada, Mexico, New Zealand, South Korea, Taiwan, and a growing list of additional countries.

- Grapes for the control of downy mildew (*Plasmopara viticola*). Compared to Badge X2, Cueva, and Oxidate, the polyoxin D zinc salt 5SC formulation offers organic grape growers:
  - Competitive or superior efficacy for control of downy mildew;
  - An opportunity to reduce the amount of copper applied to their vineyards and thereby reduce the negative effects of copper on soil;
  - Greater to significantly greater crop, worker, and environmental safety;
  - Reduced (EPA's minimum) personal protective equipment requirement;
  - Greater flexibility in growing the crop [0-day PHI instead of 1-day PHI; 4-hour worker re-entry interval instead of 48 hours (Badge X2)];
  - A reduced risk product with a new non-toxic mode of action for use in resistance management and integrated pest management (IPM); and
  - Opportunities for export of the treated crop to Canada, Mexico, New Zealand, South Korea, Taiwan, and a growing list of additional countries.

- Grapes for control of powdery mildew (*Erysiphe necator*). Compared to Micro Sulf, Lifegard WG and Stargus, the polyoxin D zinc salt 5SC formulation offers organic grape growers:
  - Competitive or superior efficacy for control of powdery mildew;
  - A treatment option ***after*** powdery mildew is first observed;
  - An opportunity to reduce the amount of copper applied to their vineyards and thereby reduce the negative effects of copper on soil;
  - Competitive or superior crop, worker, and environmental safety;
  - Greater flexibility in growing the crop [0-day PHI instead of 1-day PHI; 4-hour worker re-entry interval instead of 48 hours (Badge X2)];
  - Increased applicator comfort (no respirator is required as is required for Lifegard WG and Stargus);
  - A reduced risk product with a new non-toxic mode of action for use in resistance management and integrated pest management (IPM); and
  - Opportunities for export of the treated crop to Canada, Mexico, New Zealand, South Korea, Taiwan, and a growing list of additional countries.

- Strawberries for control of Phomopsis leaf spot (*Phomopsis obscurans*). Compared to Cueva, the polyoxin D zinc salt 5SC formulation offers organic strawberry growers:
  - Competitive efficacy for control of Phomopsis leaf spot;
  - A treatment option ***after*** Phomopsis leaf spot is first observed;
  - Competitive or superior crop, worker, and environmental safety;
  - Increased applicator comfort (no respirator is required as for Serifel);
  - A reduced risk product with a new non-toxic mode of action for use in resistance management and integrated pest management (IPM); and
  - Opportunities for export of the treated crop to Canada, Mexico, New Zealand, South Korea, Taiwan, and a growing list of additional countries.

Please note:

- For scheduling reasons, this analysis is limited to berries and small fruits and basil. Similar results are anticipated if other crop/disease combinations were analyzed.
- There is no EPA registered, OMRI-listed alternative for treatment of cranberries for control of cottonball (*Monilinia oxycocci*).

Please also note:

- The polyoxin D zinc salt 5SC formulation has been demonstrated to *improve* the performance of:
  - Double Nickel LC (containing *Bacillus amyloliquefaciens* strain D747; FRAC Code 44).
  - Actinovate (containing *Streptomyces lydicus* WYEC 108; no FRAC Code; biological);
  - Regalia (containing *Reynoutria sachalinensis* extract; FRAC Code P5); and
  - NovaSource's Lime-Sulfur (containing calcium polysulfide; FRAC Code M2).
- Polyoxin D zinc salt stops the growth of sensitive fungi. Therefore, Kaken does not recommend the use of polyoxin D zinc salt as a tank-mix partner or as part of the treatment program with products containing *Trichoderma* species [(Bio-Tam (EPA Reg. No. 80289-9), Rootshield Plus WP (EPA Reg. No. 68539-9) and Rootshield Plus Granules (EPA Reg. No. 68539-10)].

12. Describe any alternative practices that would make the use of the petitioned substance unnecessary.

For all uses of the polyoxin D zinc salt 5SC formulation included in this addendum with at least one OMRI-listed alternative product for the specified crop/disease combination, excluding strawberry/leather rot, there are OMRI-listed *synthetic* alternative products. Therefore, with the exception of strawberry/leather rot, NOP has determined that cultural practices alone are *not* sufficient to address organic grower needs.

CRITERIA

7 USC §6517(c)(1) states:

"Exemption for prohibited substances in organic production and handling operations The National List may provide for the use of substances in an organic farming or handling operation that are otherwise prohibited under this chapter only if—

(A) the Secretary determines, in consultation with the Secretary of Health and Human Services and the Administrator of the Environmental Protection Agency, that the use of such substances—

(i) would not be harmful to human health or the environment;

(ii) is necessary to the production or handling of the agricultural product because of the unavailability of wholly natural substitute products; and

(iii) is consistent with organic farming and handling."

Kaken proposed that polyoxin D zinc salt:

- Would not be harmful to human health or the environment;
- Is necessary to the production or handling of the agricultural product because of the unavailability of wholly natural substitute products;
- Is consistent with organic farming and handling; and
- Therefore qualifies for addition to 7 CFR §205.601(i) as a synthetic substance allowed for use in organic crop production as plant disease control.

LEVEL PLAYING FIELD

Kaken proposes that the National Organic Standards Board and the National Organic Program should have a level playing field when considering proposed additions to the list of synthetic substances allowed for use in organic crop production. The criteria used in the evaluation of polyoxin D zinc salt should be no more restrictive than those applied to the synthetic substances currently listed in 7 CFR §205.601(i) as permitted in organic agriculture for use on crops as plant disease control.

APPENDIX 1: VEGGIETURBO 5SC SUSPENSION CONCENTRATE FUNGICIDE EPA ACCEPTED LABEL (JANUARY 3, 2018)

068173-00004.20171218.Changes_IMPLEMENTED.pdf
VEGGIETURBO 5SC (EPA File Symbol 68173-4) • Page 1 of 23
December 18, 2017 Proposed Master Label Fast-Track Amendment
Based upon the May 16, 2017 EPA accepted label. Updated resistance management.
Cucurbit, stone fruit, and grape/berries new disease claims and new/edited application details.
"Not for use in California" statements added (artichoke, banana/plantain, ginseng, sugar beets).

[Front Panel]

Polyoxin D Zinc Salt	GROUP	19	FUNGICIDE

VEGGIETURBO™ 5SC

Suspension Concentrate Fungicide

Optional text:

For Control of Fungal Diseases of Listed Vegetable and Fruit Crops
Biofungicide For Control of Fungal Diseases of Listed Vegetable and Fruit Crops
Biochemical Fungicide For Control of Fungal Diseases of Listed Vegetable and Fruit Crops
Biofungicide
Biochemical Fungicide

Active Ingredient	
Polyoxin D zinc salt	5.0%
Other Ingredients	95.0%
Total	100.0%

Contains 7.03 ounces of active ingredient per gallon.

KEEP OUT OF REACH OF CHILDREN

CAUTION

ACCEPTED
01/03/2018
Under the Federal Insecticide, Fungicide and Rodenticide Act as amended, for the pesticide registered under EPA Reg. No. 68173-4

See back panel for additional precautionary statements.
[Alternate statements:]
See below for additional precautionary statements.
See inside panel for additional precautionary statements.
See inside panels for additional precautionary statements.
See inside panels for additional precautionary statements and directions for use.
See inside panels for additional Precautionary Statements, First Aid Statements, Directions for Use, and Storage and Disposal Statements.
See inside panels for complete label.
See booklet for additional precautionary statements.
See booklet for additional precautionary statements and directions for use.
See booklet for additional precautionary statements, directions for use, and storage and disposal statement.
See booklet for complete label
See attached booklet for additional Precautionary Statements, First Aid Statements, Directions for Use, and Storage and Disposal Statements.
See accompanying shipping documents for complete label.

[*Containers up to 2.5 gallons:*]
SHAKE WELL BEFORE USE

Produced by:
Kaken Pharmaceutical Co., Ltd.
28-8, Honkomagome 2-chome, Bunkyo-ku,
Tokyo, JAPAN 113-8650

EPA Reg. No. 68173-4
EPA Est. No. 89397-JPN-1 (or 92668-JPN-1)

NET CONTENTS: **1 Quart (32 Fluid Ounces)**
1 Gallon (128 Fluid Ounces)
2.5 Gallons (320 Fluid Ounces)
266 Gallons (1000 Liters)

[Back Panel]

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS & DOMESTIC ANIMALS

Caution. Prolonged or frequently repeated skin contact may cause allergic reactions in some individuals. Avoid contact with skin and clothing. Wash thoroughly with soap and water after handling and before eating, drinking, chewing gum, using tobacco, or using the toilet. Remove and wash contaminated clothing before reuse**.**

Optional Statements (EPA Category IV toxicity for acute oral, acute dermal, acute inhalation, eye irritation and dermal irritation)	
FIRST AID	
IF ON SKIN OR CLOTHING:	• *Take off contaminated clothing.* • *Rinse skin immediately with plenty of water for 15-20 minutes.* • *Call a poison control center or doctor for treatment advice.*
IF IN EYES:	• *Hold eye open and rinse slowly and gently with water for 15-20 minutes.* • *Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye.* • *Call a poison control center or doctor for further treatment advice.*
IF SWALLOWED:	• *Call a poison control center or doctor immediately for treatment advice.* • *Have person sip a glass of water if able to swallow.* • *Do not induce vomiting unless told to do so by the poison control center or doctor.* • *Do not give anything to an unconscious person.*
IF INHALED:	• *Move person to fresh air.* • *If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably mouth-to-mouth if possible.* • *Call a poison control center or doctor for further treatment advice.*
Have the product container or label with you when calling a poison control center or doctor, or going for treatment. *HOTLINE NUMBER: 1-800-255-3924*	

PERSONAL PROTECTIVE EQUIPMENT (PPE)

All mixers, loaders, applicators and other handlers must wear:

- Long-sleeved shirt and long pants;
- Socks;
- Shoes; and
- Chemical-resistant gloves.

Follow manufacturer's instructions for cleaning and maintaining PPE. If no instructions are available, use detergent and hot water for washables. Keep and wash PPE separately from other laundry.
When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides, the handler PPE requirements may be reduced or modified as specified in the WPS.

USER SAFETY RECOMMENDATIONS

Users should:

- Remove clothing/PPE immediately if pesticides get inside. Then wash thoroughly and put on clean clothing.
- Remove PPE immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash thoroughly and change into clean clothing.

ENVIRONMENTAL HAZARDS

[For 1 liter, 1 gallon and 2.5 gallon containers:]
For terrestrial use. This pesticide is moderately toxic to aquatic invertebrates and fish. Do not apply directly to water, or to areas where surface water is present or to intertidal areas below the mean high water mark. Do not contaminate water when disposing of equipment wash water or rinsate. Do not allow runoff into lakes, streams, ponds or public waterways. Drift and runoff may be hazardous to aquatic organisms in water adjacent to treated areas. Observe the most restrictive labeling limitations and precautions of all products used in mixtures.

[For 1000 liter container:]
For terrestrial use. This pesticide is moderately toxic to aquatic invertebrates and fish. Do not apply directly to water, or to areas where surface water is present or to intertidal areas below the mean high water mark. Do not contaminate water when disposing of equipment wash water or rinsate. Do not allow runoff into lakes, streams, ponds or public waterways. Drift and runoff may be hazardous to aquatic organisms in water adjacent to treated areas. Observe the most restrictive labeling limitations and precautions of all products used in mixtures. Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans, or other waters unless in accordance with the requirements of a National Pollutant Discharge Elimination System (NPDES) permit and the permitting authority has been notified in writing prior to discharge. Do not discharge effluent containing this product to sewer systems without previously notifying the local sewage treatment plant authority. For guidance contact your State Water Board or Regional Office of the EPA.

GENERAL INFORMATION

VEGGIETURBO 5SC can be applied as a preventative or curative treatment in conjunction with good management practices.
VEGGIETURBO 5SC can be used alone or, when diseases not specified on this label are present or expected, in combination and/or rotation with other appropriately labeled fungicides as a tool for integrated disease management in labeled agricultural crops. See "Mixing and Handling Instructions" below for additional information.
Preharvest Interval (PHI) = 0 days. VEGGIETURBO 5SC is exempt from the requirement for residue tolerance and therefore can be applied up to and including the day of harvest.

RESISTANCE MANAGEMENT RECOMMENDATIONS

This product contains a Group 19 fungicide. Any fungal population may contain individuals naturally resistant to this product and other Group 19 fungicides. A gradual or total loss of pest control may occur over time if these fungicides are used repeatedly in the same fields. Appropriate resistance management strategies should be followed. To delay fungicide resistance, take one or more of the following steps:

- Rotate the use of this product or other Group 19 fungicides within a growing season sequence with different groups that control the same pathogens. Avoid application of more than the specified maximum number of applications and 2 consecutive sprays of this product or other fungicides in the same group in a season.
- Use tank mixtures with fungicide from a different group that are equally effective on the target pest when such use is permitted. Use at least the minimum application rate as labeled by the manufacturer.
- Adopt an integrated disease management program for fungicide use that includes scouting, uses historical information related to pesticide use, and crop rotation, and which considers host plant resistance, impact of environmental conditions on disease development, disease thresholds, as well as cultural, biological and other chemical control practices.
- Where possible, make use of predictive disease models to effectively time fungicide applications. Note that using predictive models alone is not sufficient to manage resistance.
- Monitor treated fungal populations for resistance development.
- Contact your local extension specialist or certified crop advisor for any additional pesticide resistance management and/or IPM recommendations for specific crops and pathogens.
- For further information or to report suspected resistance contact your pesticide distributor or university extension specialist.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

For any requirements specific to your State or Tribe, consult the State or Tribal agency responsible for pesticide regulation.

Do not apply this product in a way that will contact workers or other persons, either directly or through drift. Only protected handlers may be in the area during application.

AGRICULTURAL USE REQUIREMENTS

Use this product only in accordance with its labeling and with the Worker Protection Standard 40 CFR Part 170. This standard contains requirements for the protection of agricultural workers on farms, forests, nurseries, and greenhouses and handlers of agricultural pesticides. It contains requirements for training, decontamination, notification, and emergency assistance. It also contains specific instructions and exceptions pertaining to the statements on this label about personal protective equipment (PPE), and restricted entry intervals. The requirements in this box only apply to uses of this product that are covered by the Worker Protection Standard.

Do not enter or allow worker entry into treated areas during the restricted entry interval (REI) of 4 hours unless wearing appropriate PPE.

PPE required for early entry to treated areas that is permitted under the Worker Protection Standard and that involves contact with anything that has been treated, such as plants, soil or water is: coveralls, socks, shoes, and chemical-resistant gloves.

MIXING AND APPLICATION INSTRUCTIONS

VEGGIETURBO 5SC may be applied by ground or aerial spray equipment, as a soil drench, or by chemigation through sprinklers or drip irrigation. See the table below for information on application methods and timing for specific crops and diseases.

For spray application, mix VEGGIETURBO 5SC in water and apply as a spray to foliage, fruit, or other above-ground plant parts. For optimum control of labeled diseases, apply in sufficient volume of water to provide thorough coverage with minimal run-off.

See "Chemigation Instructions" below for information about applying VEGGIETURBO 5SC through irrigation systems.

[For 1 quart, 1 gallon and 2.5 gallon containers:]
Mixing instructions for VEGGIETURBO 5SC:

- *Shake well before use.*
- *Fill tank with water to ½ of the intended final volume.*
- *Start agitation of the spray tank.*
- *Add the appropriate amount of product to the tank according to the rates in this label.*
- *Agitate to ensure thorough mixing while adding the remaining required water.*
- *Do not allow the mixture to stand without agitation.*
- *Mix only the amount of solution needed to treat the desired area.*

[For 1000 Liter container:]
Thoroughly agitate product when product is in use.

When tank mixing VEGGIETURBO 5SC with other products, observe all precautions and limitations on each separate product label.

When planning to mix this product with others, it advisable to conduct a "jar test" to determine the physical compatibility of this product with the others. Using a quart jar, add the products (with agitation) to approximately one quart of water in the proportions they will appear in the final mixture. Add dry formulations first, followed by flowables, then emulsifiable concentrates like VEGGIETURBO 5SC last. After thorough mixing, allow this mixture to stand for 5 minutes. If the combination remains mixed or can be readily remixed, it is physically compatible. Once compatibility has been proven, use the same sequence for adding required ingredients to the tank.

To assess the potential for phytotoxicity, test tank mixtures on a small number of plants prior to more widespread application.

If more applications or shorter intervals than indicated in the table below are needed to maintain disease control, alternate VEGGIETURBO 5SC with other fungicides having different modes of action to avoid or slow development of pathogen resistance. See "Resistance Management Recommendations" above for more information.

Use of an adjuvant may enhance spray coverage of dense crop canopy, or plants that are difficult to wet due to waxy or hairy surfaces. Use only adjuvants that are labeled for such uses. Refer to "Mixing and Application Instructions" above for information on testing physical compatibility of VEGGIETURBO 5SC with other products.

BANDED (IN-FURROW) APPLICATION

Use the table below to determine the correct application rate in fluid ounces of product per 1,000 row feet based on row spacing and desired rate per acre. Mix the required amount of VEGGIETURBO 5SC in water and apply as banded spray (4" to 6" wide) or seedline drench centered over the planting furrow. Apply to soil immediately before seeding or directly over seeds in the furrow just before they are covered with soil. The volume of water required per acre or per 1,000 row feet will depend on the application equipment used. Consult your local cooperative extension service if you need assistance calibrating band spraying equipment.

Rates for banded (in-furrow) application: Find desired application rate in the left column. Read across the line to the correct row spacing indicated at the top to find the number of fluid ounces per 1000 row feet that will provide the desired application rate per acre.

Fluid oz. per acre	Fluid ounces per 1000 row feet														
	Space between rows (inches)														
	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
6.50	0.15	0.17	0.20	0.22	0.25	0.27	0.30	0.32	0.35	0.37	0.40	0.42	0.45	0.47	0.50
13.00	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	0.99

CHEMIGATION INSTRUCTIONS

GENERAL INFORMATION:

- Apply this product only through pressurized irrigation systems such as sprinkler irrigation including center pivot, lateral move, end tow, side (wheel) roll, traveler, big gun, solid set, or hand move; or drip (trickle) irrigation systems. Do not apply this product through any other type of irrigation system.
- Crop injury or lack of effectiveness can result from non-uniform distribution of treated water.
- If you have questions about calibration, you should contact State Extension Service specialists, equipment manufacturers or other experts.
- Do not connect an irrigation system (including greenhouse systems) used for pesticide application to a public water system unless the pesticide label-prescribed safety devices for public water systems are in place.
- A person knowledgeable of the chemigation system and responsible for its operation, or under the supervision of the responsible person, shall shut the system down and make necessary adjustments should the need arise.
- Public water system means a system for the provision to the public of piped water for human consumption if such system has at least 15 service connections or regularly serves an average of at least 25 individuals daily at least 60 days out of the year.
- Chemigation systems connected to public water systems must contain a functional, reduced-pressure zone, back flow preventer (RPZ) or the functional equivalent in the water supply line upstream from the point of pesticide introduction. As an option to the RPZ, the water from the public water system should be discharged into a reservoir tank prior to pesticide introduction. There shall be a complete physical break (air gap) between the outlet end of the fill pipe and the top or overflow rim of the reservoir tank of at least twice the inside diameter of the fill pipe.

- The pesticide injection pipeline must contain a functional, automatic, quick-closing check valve to prevent the flow of fluid back toward the injection.
- The pesticide injection pipeline must contain a functional, normally closed, solenoid-operated valve located on the intake side of the injection pump and connected to the system interlock to prevent fluid from being withdrawn from the supply tank when the irrigation system is either automatically or manually shut down.
- The system must contain functional interlocking controls to automatically shut off the pesticide injection pump when the water pump motor stops, or in cases where there is no water pump, when the water pressure decreases to the point where pesticide distribution is adversely affected.
- Systems must use a metering pump, such as a positive displacement injection pump (e.g., diaphragm pump) effectively designed and constructed of materials that are compatible with pesticides and capable of being fitted with a system interlock.
- Do not apply when wind speed favors drift beyond the area intended for treatment.
- Dilute the product in water following the label mixing directions. It may be premixed in a supply tank with water, fertilizer or other appropriate tank-mixed agricultural chemicals. Agitation is necessary. Apply to moderately moist soils. Use volumes that thoroughly wet the soil but that do not cause significant runoff or excessive drip from pots. Application should be continuous in sufficient water to apply the recommended rate evenly to the entire treated area.
- Remove scale, pesticide residues, and other foreign matter from the chemical supply tank and injector system and flush with clean water before use. Failure to provide a clean tank, free of scale or residues may reduce effectiveness of this product.

DRIP (TRICKLE) AND MICRO-IRRIGATION CHEMIGATION:

- The system must contain a functional check valve, vacuum relief valve and low pressure drain appropriately located on the irrigation pipeline to prevent water source contamination from back flow.
- The pesticide injection pipeline must contain a functional, automatic, quick-closing check valve to prevent the flow of fluid back toward the injection pump.
- The pesticide injection pipeline must also contain a functional, normally closed, solenoid-operated valve located on the intake side of the injection pump and connected to the system interlock to prevent fluid from being withdrawn from the supply tank when the irrigation system is either automatically or manually shut down.
- The system must contain functional interlocking controls to automatically shut off the pesticide injection pump when the water pump motor stops.
- The irrigation line or water pump must include a functional pressure switch which will stop the water pump motor when the water pressure decreases to the point where pesticide distribution is adversely affected.
- Systems must use a metering pump such as a positive displacement injection pump (e.g., diaphragm pump) effectively designed and constructed of materials that are compatible with pesticides and capable of being fitted with a system interlock.
- Dilute the product in water following the label mixing directions. It may be premixed in a supply tank with water, fertilizer, or other appropriate tank-mixed agricultural chemicals. Agitation is necessary. Apply to moderately moist soils. Use volumes that thoroughly wet the soil but that do not cause significant runoff or excessive drip from pots. Application should be continuous in sufficient water to apply the recommended rate evenly to the entire treated area.

SPRINKLER CHEMIGATION:

- The system must contain a functional check valve, vacuum relief valve, and low pressure drain appropriately located on the irrigation pipeline to prevent water source contamination from back flow.
- The pesticide injection pipeline must contain a functional, automatic, quick-closing check valve to prevent the flow of fluid back toward the injection pump.
- The pesticide injection pipeline must also contain a functional, normally closed, solenoid-operated valve located on the intake side of the injection pump and connected to the system interlock to prevent fluid from being withdrawn from the supply tank when the irrigation system is either automatically or manually shut down.
- The system must contain functional interlocking controls to automatically shut off the pesticide injection pump when the water pump motor stops.
- The irrigation line or water pump must include a functional pressure switch which will stop the water pump motor when the water pressure decreases to the point where pesticide distribution is adversely affected.
- Systems must use a metering pump, such as a positive displacement injection pump (e.g., diaphragm pump) effectively designed and constructed of materials that are compatible with pesticides and capable of being fitted with a system interlock.

- Dilute the product in water following the label mixing directions. It may be premixed in a supply tank with water, fertilizer or other appropriate tank-mixed agricultural chemicals. Agitation is necessary. Apply to moderately moist soils. Use volumes that thoroughly wet the soil but that do not cause significant runoff or excessive drip from pots. Application should be continuous in sufficient water to apply the recommended rate evenly to the entire treated area.
- Do not apply when wind speed favors drift beyond the area intended for treatment.

CROPS, DISEASES AND APPLICATION RATES

CROP GROUP 1: ROOT AND TUBER VEGETABLES: Carrots and Parsnips		
DISEASES/PATHOGENS	**RATES**	**ADDITIONAL INFORMATION**
Alternaria leaf blight (*Alternaria dauci*) **Cercospora leaf blight** (*Cercospora carotae*) **Powdery mildew** (*Erysiphe polygoni*) **Rhizoctonia crown rot and leaf blight** (*Rhizoctonia solani*)	6.5 – 13.0 fl. oz./acre (0.42 – 0.72 oz. a.i./acre) Do not apply more than 4.2 oz. a.i./acre/season (6 appl. at max. rate).	Begin applications soon after plant emergence and repeat on 7-14 day interval as long as conditions favor disease development. Apply as a foliar spray in sufficient water to achieve thorough coverage of all above- ground plant parts. May also be applied through overhead sprinkler irrigation. See "Chemigation Instructions" for additional information.
A rate of 6.5 fl. oz./acre may be used for preventative applications before onset of visible disease, in periods of low disease pressure, or in a tank mix with other fungicides for resistance management. Otherwise, use a rate of 13.0 fl. oz./acre.		

CROP GROUP 1: ROOT AND TUBER VEGETABLES: Ginseng †		
DISEASES/PATHOGENS	**RATES**	**ADDITIONAL INFORMATION**
Alternaria blight (*Alternaria panax*) **Botrytis blight** (*Botrytis cinerea*)	6.5 – 13.0 fl. oz./acre (0.42 – 0.72 oz. a.i./acre) Do not apply more than 4.2 oz. a.i./acre/season (6 appl. at max. rate).	Apply as foliar spray every 7-10 days beginning within 2 weeks after plant emergence, prior to disease development (consult local extension service for advice on timing against these diseases). Continue throughout the season as needed to maintain control.
Cylindrocarpon root rot (*Cylindrocarpon destructans*) **Rhizoctonia root and crown rot** (*Rhizoctonia solani*)		Apply as soil drench every 14-28 days, beginning within 2 weeks after plant emergence.
A rate of 6.5 fl. oz./acre may be used for preventative applications before onset of visible disease, in periods of low disease pressure, or in a tank mix with other fungicides for resistance management. Otherwise, use a rate of 13.0 fl. oz./acre. † Not for use in California.		

CROP GROUP 1: ROOT AND TUBER VEGETABLES: Potatoes		
DISEASES/PATHOGENS	**RATES**	**ADDITIONAL INFORMATION**
Black scurf (*Rhizoctonia solani*)	6.5 – 13.0 fl. oz./acre (0.42 – 0.72 oz. a.i./acre) Do not apply more than 4.2 oz. a.i./acre/season (6 appl. at max. rate).	Apply as banded spray in-furrow at planting, either just before placement of seed pieces or over seed pieces before covering with soil. See additional instructions under BANDED (IN-FURROW) APPLICATION.
Early blight (*Alternaria solani*) **Late blight** (*Phytophthora infestans*)*		Apply as a foliar spray in sufficient water to provide thorough coverage of all foliage. May also be applied through overhead sprinkler irrigation. See "Chemigation Instructions" for additional information. Begin as a preventative application and continue on a 7-14 day interval as needed to maintain control.
White mold (*Sclerotinia sclerotiorum*)		Apply in 30 – 50 gallons of water per acre as a directed spray toward soil surface, lower leaves, and stems. May also be applied through overhead sprinkler irrigation. See "Chemigation Instructions" for additional information.
* Suppression only. A rate of 6.5 fl. oz./acre may be used for preventative applications before onset of visible disease, in periods of low disease pressure, or in a tank mix with other fungicides for resistance management. Otherwise, use a rate of 13.0 fl. oz./acre.		

CROP GROUP 1: ROOT AND TUBER VEGETABLES: Sugar Beet †		
DISEASES/PATHOGENS	**RATES**	**ADDITIONAL INFORMATION**
Cercospora leaf spot (*Cercospora beticola*)	6.5 – 13.0 fl. oz./acre (0.42 – 0.72 oz. a.i./acre) Do not apply more than 4.2 oz. a.i./acre/season (6 appl. at max. rate).	Begin applications at first sign of disease symptoms and repeat on 7-14 day interval as long as conditions favor disease development. Apply as a foliar spray in sufficient water to achieve thorough coverage of all above- ground plant parts. May also be applied through overhead sprinkler irrigation. See "Chemigation Instructions" for additional information.
Rhizoctonia crown and root rot (*Rhizoctonia solani*)		Apply as banded spray or drench in seed furrow at planting. See additional instructions below for banded application rates. Can also be applied through overhead sprinkler irrigation. See "Chemigation Instructions" for additional information. Make subsequent applications at 7-14 day intervals either through chemigation, or as a spray/drench directed at the base of each plant.
A rate of 6.5 fl. oz./acre may be used for preventative applications before onset of visible disease, in periods of low disease pressure, or in a tank mix with other fungicides for resistance management. Otherwise, use a rate of 13.0 fl. oz./acre. † Not for use in California.		

CROP GROUP 3: BULB VEGETABLES: Chive, Daylily, Elegans hosta, Fritillaria, Garlic, Kurrat, Lady's leek, Leek, Lily, Onion, Shallot, Cultivars, varieties, and/or hybrids of these		
DISEASES/PATHOGENS	**RATES**	**ADDITIONAL INFORMATION**
Alternaria blight and Purple blotch (*Alternaria* spp.) **Botrytis leaf blight /Leaf spot/Neck rot** (*Botrytis* spp.) **Downy mildew** (*Peronospora* spp.)* **Rust** (*Puccinia alii* or *Puccinia porri*)	6.5 – 13.0 fl. oz./acre (0.42 – 0.72 oz. a.i./acre) Do not apply more than 4.2 oz. a.i./acre/season (6 appl. at max. rate).	Apply as foliar preventative spray (ground, aerial, or through overhead sprinklers) before disease onset and continue at 7-14 day intervals as needed to maintain control. Coverage may be enhanced by use of a spray adjuvant.
* Suppression only. A rate of 6.5 fl. oz./acre may be used for preventative applications before onset of visible disease, in periods of low disease pressure, or in a tank mix with other fungicides for resistance management. Otherwise, use a rate of 13.0 fl. oz./acre.		

CROP GROUP 4: LEAFY VEGETABLES (EXCEPT BRASSICA VEGETABLES):
Amaranth, Arugula (garden rocket), Asparagus chicory, Beet greens (spinach beet), Borage, Catalogna, Celery, Chard, Chaya, Chicory, Colocasia, Corn salad (mâche), Dandelion, Endive, Escarole, Fenugreek, Garden cress, Ground-elder, Kailan, Lettuce (Head, Leaf, Iceberg, Romaine), Mizuna, Purslane, Radichetta, Radicchio, Sorrel, Spinach, Spinach beet (beet greens), Spring greens (Spring mix), Stinging nettle, Tatsoi, Tropaeolum (*Nasturtium*), Turnip greens, Watercress (*Nasturtium*), Water spinach (ong choy), Yarrow

DISEASES/PATHOGENS	RATES	ADDITIONAL INFORMATION
Alternaria leaf spot (*Alternaria* spp.) **Downy mildew** (*Bremia lactucae* and *Peronospora* spp.)* **Powdery mildew** (*Golovinomyces (Erysiphe) cichoracearum*) **White rust** (*Albugo occidentalis*)	6.5 – 13.0 fl. oz./acre (0.42 – 0.72 oz. a.i./acre) Do not apply more than 4.2 oz. a.i./acre/season (6 appl. at max. rate).	Begin applications soon after plant emergence or transplanting and repeat on 7-14 day interval as long as conditions favor disease development. Apply as a foliar spray in sufficient water to achieve thorough coverage of all above- ground plant parts.
Botrytis damping off (*Botrytis* spp.)		Apply as banded spray (4-6" wide) over the seed furrow at planting or transplanting. See additional instructions under BANDED (IN-FURROW) APPLICATION.
Botrytis leaf blight, **Botrytis rot** (*Botrytis* spp.)		Begin preventative foliar applications when conditions favor disease development and continue at 7-14 day intervals as long as needed to maintain control.
Bottom rot (*Rhizoctonia solani*)		Apply in 30 – 50 gallons of water per acre as a directed spray toward soil surface and lower leaves. Begin applications at head formation, before leaves contact the ground. Repeat every 7-14 days as needed to maintain control.
Lettuce drop (*Sclerotinia* spp.)		Apply in 30 – 50 gallons of water per acre as a directed spray toward soil surface and lower leaves. Make first application to direct-seeded lettuce immediately after emergence. For transplanted lettuce, make first application immediately after transplanting. In both cases, apply prior to disease development. Apply again if soil is disturbed by cultivation or thinning and conditions continue to favor disease development.

* Suppression only.
- May also be applied through overhead sprinkler irrigation. See "Chemigation Instructions" for additional information.
- A rate of 6.5 fl. oz./acre may be used for preventative applications before onset of visible disease, in periods of low disease pressure, or in a tank mix with other fungicides for resistance management. Otherwise, use a rate of 13.0 fl. oz./acre.

CROP GROUP 5: BRASSICA (COLE) LEAFY VEGETABLES: Broccoli, Broccoli raab, Brussels Sprouts, Cabbage, Chinese broccoli, Chinese Cabbage (Bok Choi, Napa, Gai choy), Cauliflower, Cavalo broccolo, Collards, Kale, Kohlrabi, Mizuna, Mustard Greens, Mustard spinach, Rape greens		
DISEASES/PATHOGENS	**RATES**	**ADDITIONAL INFORMATION**
Alternaria leaf spot (*Alternaria* spp.) **Anthracnose** (*Colletotrichum* spp.) **Gray mold** (*Botrytis cinerea*) **White spot** (*Cercosporella* spp.)	6.5 – 13.0 fl. oz./acre (0.42 – 0.72 oz. a.i./acre) Do not apply more than 4.2 oz. a.i./acre/season (6 appl. at max. rate).	Apply as a foliar spray in sufficient water to attain thorough coverage. Use of an adjuvant may enhance spray coverage, especially of waxy leaves. Begin preventive sprays when conditions favor disease development, and continue on a 7-14 day spray interval as needed.
Bottom rot (*Rhizoctonia solani*) **Sclerotinia rot** (*Sclerotinia sclerotiorum)*		Apply in 30 – 50 gallons of water per acre as a directed spray toward soil surface and lower leaves. Begin applications at head formation, before leaves contact the ground. Repeat every 7-14 days as needed to maintain control.
A rate of 6.5 fl. oz./acre may be used for preventative applications before onset of visible disease, in periods of low disease pressure, or in a tank mix with other fungicides for resistance management. Otherwise, use a rate of 13.0 fl. oz./acre.		

CROP GROUP 6: LEGUME VEGETABLES (SUCCULENT OR DRIED): Bean (Lupines spp.), Bean (*Phaseolus* spp., including Field bean, Kidney bean, Lima bean, Navy bean, Pinto bean, Runner bean, Snap bean, Tepary bean, Wax bean), Bean (*Vigna* spp., including Adzuki bean, Asparagus bean, Blackeyed pea, Catjang, Chinese longbean, Cowpea, Crowder pea, Moth bean, Mung bean, Southern pea, Urd bean, Yardlong bean) Broad bean (Fava bean), Chickpea (Garbanzo bean), Guar, Jackbean, Lablab bean (hyacinth bean), Lentil, Pea (*Pisum* spp., including Dwarf pea, Edible pod pea, English pea, Field pea, Garden pea, Green pea, Snow pea, Sugar snap pea), Pigeon pea, Soybean, Sward bean.		
DISEASES/PATHOGENS	**RATES**	**ADDITIONAL INFORMATION**
Asian Soybean Rust (*Phakopsora pachyrhizi*) **Gray mold** (*Botrytis cinerea*) **Powdery mildew** (*Erysiphe pisi*)	6.5 – 13.0 fl. oz./acre (0.42 – 0.72 oz. a.i./acre) Do not apply more than 4.2 oz. a.i./acre/season (6 appl. at max. rate).	Begin applications at first sign of disease symptoms and repeat on 7-14 day interval as long as conditions favor disease development. Apply as a foliar spray in sufficient water to achieve thorough coverage of all above- ground plant parts. May also be applied through overhead sprinkler irrigation. See "Chemigation Instructions" for additional information.
Stem rot / White mold (*Sclerotinia sclerotiorum*)		Apply in 30 – 50 gallons of water per acre as a directed spray toward soil surface, lower leaves, and stems. May also be applied through overhead sprinkler irrigation. See "Chemigation Instructions" for additional information.
A rate of 6.5 fl. oz./acre may be used for preventative applications before onset of visible disease, in periods of low disease pressure, or in a tank mix with other fungicides for resistance management. Otherwise, use a rate of 13.0 fl. oz./acre.		

CROP GROUP 8: FRUITING VEGETABLES: Eggplant, Groundcherry, Peppers (all types), Tomatillo, Tomatoes (all types)		
DISEASES/PATHOGENS	**RATES**	**ADDITIONAL INFORMATION**
Anthracnose (*Colletotrichum* spp.)* **Early blight** (*Alternaria solani*) **Gray mold/Botrytis rot** (*Botrytis* spp.) **Late blight*** (*Phytophthera infestans*) **Leaf mold** (*Fulvia (Cladosporium) fulvum,* also known as *Passalora fulva*) **Powdery mildew** (*Leveillula, Oidiopsis, Erysiphe*, and *Sphaerotheca* spp.) **Target spot** (*Corynespora cossiicola*)*	6.5 – 13.0 fl. oz./acre (0.42 – 0.72 oz. a.i./acre) Do not apply more than 4.2 oz. a.i./acre/season (6 appl. at max. rate).	Apply as a preventative foliar spray when conditions favor disease development. Repeat application at 7-14 day intervals as needed during infection periods. Mix in sufficient water to attain thorough coverage of foliage and fruit (if present).
Southern blight (*Sclerotium rolfsii*)* **Verticillium wilt** (*Verticillium dahliae*)*		See additional instructions under BANDED (IN-FURROW) APPLICATION. Can also be applied through surface (not buried) drip or overhead sprinkler irrigation. See "Chemigation Instructions" for additional information. Make subsequent applications at 7-14 day intervals either through surface drip or overhead sprinkler irrigation, or as a spray/drench directed at the base of each plant.

* Suppression only.
A rate of 6.5 fl. oz./acre may be used for preventative applications before onset of visible disease, in periods of low disease pressure, or in a tank mix with other fungicides for resistance management. Otherwise, use a rate of 13.0 fl. oz./acre.

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December 18, 2017 Proposed Master Label Fast-Track Amendment
Based upon the May 16, 2017 EPA accepted label. Updated resistance management.
Cucurbit, stone fruit, and grape/berries new disease claims and new/edited application details.
"Not for use in California" statements added (artichoke, banana/plantain, ginseng, sugar beets).

CROP GROUP 9: CUCURBIT VEGETABLES: **Chayote (fruit), Chinese waxgourd (Chinese preserving melon), Citron melon, Cucumber, Gherkin, Gourd (edible, including hyotan, cucuzza, hechima, Chinese okra),** *Momordica* **spp. (includes balsam apple, balsam pear, bitter melon, Chinese cucumber), Muskmelon (includes true cantaloupe, cantaloupe, casaba, crenshaw melon, golden pershaw melon, honeydew melon, honey balls, mango melon, Persian melon, pineapple melon, Santa Claus melon, and snake melon), Pumpkin, Squash (including acorn squash, butternut squash, calabaza, crookneck squash, hubbard squash, scallop squash, spaghetti squash, straightneck squash, vegetable marrow, zucchini), Watermelon, Hybrids and varieties of these**		
DISEASES/PATHOGENS	**RATES**	**ADDITIONAL INFORMATION**
Anthracnose (*Colletotrichum orbiculare*) **Downy mildew** (*Pseudoperonospora cubensis*)* **Early blight** (*Alternaria* sp.) **Gray mold** (*Botrytis* sp.) **Gummy stem blight** (*Didymella bryoniae* and *Phoma cucurbitacearum*) **Powdery mildew** (*Erysiphe* and *Sphaerotheca* spp. and *Podosphaera xanthii*) **Scab** (*Cladosporium* sp.) **Target leaf spot/Corynespora leaf spot/ Corynespora blight** (*Corynespora crassiicola*)	6.5 – 13.0 fl. oz./acre (0.42 – 0.72 oz. a.i./acre) Do not apply more than 4.2 oz. a.i./acre/season (6 appl. at max. rate).	Mix in sufficient volume of water for good spray coverage (typically 50-100 gallons per acre). Begin preventive sprays when conditions favor disease development, and continue on a 7-14 day spray interval as needed. For *Downy mildew*, begin preventive sprays when conditions favor disease development, and continue on a 5-8 day spray interval as needed.
Southern blight (*Sclerotium rolfsii*)		See additional instructions under BANDED (IN-FURROW) APPLICATION. Can also be applied through surface (not buried) drip or overhead sprinkler irrigation. See "Chemigation Instructions" for additional information. Make subsequent applications at 7-14 day intervals either through surface drip or overhead sprinkler irrigation, or as a spray/drench directed at the base of each plant.
* Suppression only. A rate of 6.5 fl. oz./acre may be used for preventative applications before onset of visible disease, in periods of low disease pressure, or in a tank mix with other fungicides for resistance management. Otherwise, use a rate of 13.0 fl. oz./acre.		

CROP GROUP 10: CITRUS FRUITS: Calamondin, Citron, Citrus hybrids (Chironja, Tangelo, Tangor), Clementine, Grapefruit, Kumquat, Lemon, Lime, Mandarin (Tangerine), Orange, Pummelo, Sutsuma mandarin		
DISEASES/PATHOGENS	**RATES**	**ADDITIONAL INFORMATION**
Alternaria **brown spot** (*Alternaria alternata*)	6.5 – 13.0 fl. oz./acre (0.42 – 0.72 oz. a.i./acre) Do not apply more than 4.2 oz. a.i./acre/season (6 appl. at max. rate).	Apply as preventative foliar spray before disease development, when spring flush is ¼ to ½ expanded. If needed, make second application to fully expanded flush.
Botrytis rot (*Botrytis cinerea*)		Begin preventative applications during bloom when rain or fog is expected. Repeat every 7-14 days as long as conditions favoring disease persist.
Septoria spot (*Septoria citri*)		Apply as a preventative spray in late fall or early winter, just before or after the first rain. Additional applications may be necessary during seasons of heavy rainfall.
A rate of 6.5 fl. oz./acre may be used for preventative applications before onset of visible disease, in periods of low disease pressure, or in a tank mix with other fungicides for resistance management. Otherwise, use a rate of 13.0 fl. oz./acre.		

CROP GROUP 11: POME FRUITS: Apple, Crabapple, Loquat, Mayhaw, Pear, Quince		
DISEASES/PATHOGENS	**RATES**	**ADDITIONAL INFORMATION**
Alternaria leaf spot (*Alternaria mali*) **Leaf blotch** (*Diplocarpon mali*) **Powdery mildew** (*Podosphaera leucotricha*, *Phyllactinia mali*) **Scab** (*Venturia* spp.)*	6.5 – 13.0 fl. oz./acre (0.42 – 0.72 oz. a.i./acre) Do not apply more than 4.2 oz. a.i./acre/season (6 appl. at max. rate).	Apply as foliar spray in sufficient water to attain thorough coverage of foliage and fruit. For <u>*Powdery mildew*</u> control, begin as preventative and repeat on 7-14 day interval as needed. Use in an alternating program with a sterol inhibitor (DMI) fungicide. For <u>*Scab suppression*</u>, begin sprays at green tip and continue every 7-10 days as needed.
* Suppression only. A rate of 6.5 fl. oz./acre may be used for preventative applications before onset of visible disease, in periods of low disease pressure, or in a tank mix with other fungicides for resistance management. Otherwise, use a rate of 13.0 fl. oz./acre.		
Alternaria rot (*Alternaria tenuis*) **Bitter rot** (*Glomerella cingulata*) **Cedar apple rust**** (*Gymnosporangium juniperi-virginianae*) **Flyspeck** (*Schizothyrium pomi*, formerly *Microthyriella rubi*) **Sooty blotch** (*Gloeodes pomigena*) **White rot**** (*Botryosphaeria dothidea*)	6.5 fl. oz./acre (0.42 - 0.36 oz. a.i./acre) Do not apply more than 2.16 oz. a.i./acre/season (6 appl. at max. rate).	Begin applications prior to disease development. Repeat at 7-10 day interval as needed. May be applied from green-tip to day of harvest.
** Suppression only.		

CROP GROUP 12: STONE FRUITS: Apricot (including Japanese), Capulin, Cherry (including Black, Nanking, Sweet, Tart), Jujube (Chinese), Nectarine, Peach, Plum (including American, Beach, Canada, Cherry, Chickasaw, Damson, Japanese, Klamath, prune), Plumcot, Sloe, Cultivars, varieties, and/or hybrids of these.		
DISEASES/PATHOGENS	**RATES**	**ADDITIONAL INFORMATION**
Botrytis blossom blight (*Botrytis cinerea*) **Leaf curl** (*Taphrina demormans*)* **Monilinia brown rot blossom blight** Monilinia brown rot fruit rot (*Monilinia* sp.) **Powdery mildew** (*Podosphaera* spp., *Sphaerotheca pannosa*) Scab (*Cladosporium carpophilum*)*	6.5 – 13.0 fl. oz./acre (0.42 – 0.72 oz. a.i./acre) Do not apply more than 4.2 oz. a.i./acre/season (6 appl. at max. rate).	Apply as foliar spray in sufficient water to attain thorough coverage of foliage and fruit. For *Botrytis blossom blight* control, apply at full bloom if wet weather occurs during bloom. For *Leaf curl suppression and Scab* suppression, apply preventatively at bud swell. Repeat on 14-28 day intervals as needed. For *Monilinia brown rot blossom blight and fruit rot* control, apply preventatively when conditions favor disease development. Repeat on 7-14 day interval as needed. For preventative control of post-harvest brown rot fruit rot, apply at 6.5 fl. oz./acre up to 3 days pre-harvest. For *Powdery mildew* control, begin as preventative and repeat on 7-14 day interval as needed. Use in an alternating program with a sterol inhibitor (DMI) fungicide.
* Suppression only. A rate of 6.5 fl. oz./acre may be used for preventative applications before onset of visible disease, in periods of low disease pressure, or in a tank mix with other fungicides for resistance management. Otherwise, use a rate of 13.0 fl. oz./acre.		

CROP GROUP 13-07: BERRIES AND SMALL FRUITS
[Excluding Blueberry (highbush and lowbush), Cranberry, Grape, and Strawberry]:
Amur river grape; Aronia berry; Bayberry; Bearberry; Bilberry;
Blackberry (including Andean blackberry, arctic blackberry, bingleberry, black satin berry, boysenberry, brombeere, California blackberry, Chesterberry, Cherokee blackberry, Cheyenne blackberry, common blackberry, coryberry, darrowberry, dewberry, Dirksen thornless berry, evergreen blackberry, Himalayaberry, hullberry, lavacaberry, loganberry, lowberry, Lucretiaberry, mammoth blackberry, marionberry, mora, mures deronce, nectarberry, Northern dewberry, olallieberry, Orgeon evergreen berry, phenomenalberry, rangeberry, ravenberry, rossberry, Shawnee blackberry, Southern dewberry, tayberry, youngberry, zarzamora, and cultivars, varieties and/or hybrids of these);
Buffalo currant; Buffaloberry; Che; Chilean guava; Chokecherry; Cloudberry; highbush; Currant, black; Currant, red; Elderberry; European barberry; Gooseberry; Honeysuckle, edible; Huckleberry; Jostaberry; Juneberry (Saskatoon berry); Kiwifruit, fuzzy; Kiwifruit, hardy; Lingonberry; Maypop; Mountain pepper berries; Mulberry; Muntries; Native currant; Partridgeberry; Phalsa; Pincherry; Raspberry, black and red; Riberry; salal; schisandra berry; Sea buckthorn; Serviceberry; Wild raspberry; cultivars, varieties, and/or hybrids of these

SEE SEPARATE TABLES FOR BLUEBERRIES, CRANBERRIES, GRAPES, AND STRAWBERRIES.

DISEASES/PATHOGENS	RATES	ADDITIONAL INFORMATION
Alternaria **leaf spot and fruit rot** (*Alternaria* spp.) **Anthracnose leaf & fruit rot** (*Colletotrichum* spp.)* **Gray mold/fruit rot/Botrytis blight** (*Botrytis cinerea*) **Powdery mildew** (*Sphaerotheca macularis*, *Erysiphe* spp.) Yellow rust (*Phragmidium rubi-idaei*)	6.5 – 13.0 fl. oz./acre (0.42 – 0.72 oz. a.i./acre) Do not apply more than 4.2 oz. a.i./acre/season (6 appl. at max. rate).	Apply as a foliar spray in sufficient water to provide thorough coverage. Can also be applied through overhead sprinkler irrigation. See "Chemigation Instructions" for additional information. Begin as a preventative application and continue on a 7-14 day interval as needed to maintain control. For control of *Botrytis* and other fruit diseases, begin applications at flowering.

* Suppression only.
A rate of 6.5 fl. oz./acre may be used for preventative applications before onset of visible disease, in periods of low disease pressure, or in a tank mix with other fungicides for resistance management. Otherwise, use a rate of 13.0 fl. oz./acre.

CROP GROUP 13-07: BERRIES AND SMALL FRUITS: Blueberries, highbush and lowbush		
DISEASES/PATHOGENS	**RATES**	**ADDITIONAL INFORMATION**
Alternaria **leaf spot and fruit rot** (*Alternaria* spp.) **Anthracnose leaf & fruit rot** (*Colletotrichum* spp.)* **Gray mold/fruit rot/Botrytis blight** (*Botrytis cinerea*) **Mummyberry** (*Monilinia vaccinii-corymbosi*) **Powdery mildew** (*Sphaerotheca macularis*, *Erysiphe* spp.)	6.5 – 13.0 fl. oz./acre (0.42 – 0.72 oz. a.i./acre) Do not apply more than 4.2 oz. a.i./acre/season (6 appl. at max. rate).	Apply as a foliar spray in sufficient water to provide thorough coverage. Can also be applied through overhead sprinkler irrigation. See "Chemigation Instructions" for additional information. Begin as a preventative application and continue on a 7-14 day interval as needed to maintain control. For control of *Botrytis and other fruit diseases,* begin applications at flowering. For control of *Mummyberry*, begin applications at early green tip.
* Suppression only. A rate of 6.5 fl. oz./acre may be used for preventative applications before onset of visible disease, in periods of low disease pressure, or in a tank mix with other fungicides for resistance management. Otherwise, use a rate of 13.0 fl. oz./acre.		

CROP GROUP 13-07: BERRIES AND SMALL FRUITS: Cranberries		
DISEASES/PATHOGENS	**RATES**	**ADDITIONAL INFORMATION**
Cottonball (*Monilinia oxycocci*) **Cranberry Fruit Rot Complex** (*Allantophompsis* sp., *Botrytis cinerea,* *Colletotrichum acutatum*, *Colletotrichum gloeosporioides*, *Coloepnoma empetri*, *Fusicoccum putrefaciens*, *Glomerella cingulata**, *Phomopsis vaccinii*, *Physalospora vaccinii*, *Phyllosticta vaccinii*)	6.5 – 13.0 fl. oz./acre (0.42 – 0.72 oz. a.i./acre) Do not apply more than 4.2 oz. a.i./acre/season (6 appl. at max. rate).	Apply as a foliar spray in sufficient water to provide thorough coverage. Can also be applied through overhead sprinkler irrigation. See "Chemigation Instructions" for additional information. For *Cottonball*, begin as a preventative application at 10% bloom. Continue on a 7-14 day interval as needed to maintain control. For *Cranberry fruit rot complex*, begin as a preventative application at 40% bloom. Continue on a 7-14 day interval as needed to maintain control. For best performance, apply in 20 gallons water/acre.
* Suppression only. A rate of 6.5 fl. oz./acre may be used for preventative applications before onset of visible disease, in periods of low disease pressure, or in a tank mix with other fungicides for resistance management. Otherwise, use a rate of 13.0 fl. oz./acre.		

CROP GROUP 13-07: BERRIES AND SMALL FRUITS: Grapes: For pre-harvest use on all grapes		
DISEASES/PATHOGENS	**RATES**	**ADDITIONAL INFORMATION**
Black rot (*Guignardia bidwellii*)* **Downy mildew** (*Plasmopara viticola*) **Gray mold/bunch rot** (*Botrytis cinerea*) **Phomopsis fruit rot** (*Phomopsis viticola*) **Powdery mildew** (*Erysiphe* (*Uncinula*) *necator*)	6.5 – 13.0 fl. oz./acre (0.42 – 0.72 oz. a.i./acre) Do not apply more than 4.2 oz. a.i./acre/season (6 appl. at max. rate).	For *Black rot* suppression, begin as a preventative spray when shoots are 3-5 inches long. Repeat every 7-14 days as needed to maintain control. For *Downy mildew* and *Phomopsis fruit rot*, begin as a preventative spray when shoots are 3-5 inches long. Repeat every 7-14 days as needed to maintain control. For *Gray mold / Bunch rot*, begin application at early bloom. Apply a maximum of 6 applications per season at a minimum of 7-day intervals. For optimal control, include application at veraison as one of the 6 applications. For *Powdery mildew*, begin as a preventative spray and repeat every 14 days as needed to maintain control.
A rate of 6.5 fl. oz./acre may be used for preventative applications before onset of visible disease, in periods of low disease pressure, or in a tank mix with other fungicides for resistance management. Otherwise, use a rate of 13.0 fl. oz./acre. * Suppression only.		

CROP GROUP 13-07: BERRIES AND SMALL FRUITS: Strawberries		
DISEASES/PATHOGENS	**RATES**	**ADDITIONAL INFORMATION**
Alternaria **leaf spot and fruit rot** (*Alternaria* spp.) **Anthracnose fruit rot** (*Colletotrichum acutatum*, *C. dematium*) **Common leaf spot** (*Mycosphaerella fragariae*) **Gray mold/fruit rot/Botrytis blight** (*Botrytis cinerea*) **Leather rot** (*Phytophthora cactorum*) **Phomopsis leaf spot and fruit rot** (*Phomopsis obscurans*) **Powdery mildew** (*Sphaerotheca macularis*, *Erysiphe* spp.) **Rhizopus soft rot** (*Rhizopus* sp. and *Mucor* sp.) **Tan brown rot** (*Hainesia lythri*)	6.5 – 13.0 fl. oz./acre (0.42 – 0.72 oz. a.i./acre) Do not apply more than 4.2 oz. a.i./acre/season (6 appl. at max. rate).	Apply as a foliar spray in sufficient water to provide thorough coverage. Can also be applied through overhead sprinkler irrigation. See "Chemigation Instructions" for additional information. For *Alternaria, Anthracnose fruit rot, Common leaf spot, Gray mold, Leather rot, Phomopsis leaf spot and fruit rot, Powdery mildew*, and *Tan brown rot*, begin as a preventative application and continue on a 7-14 day interval as needed to maintain control. For *Rhizopus soft rot*, begin as a preventative application and continue on a 7-10 day spray interval as needed to maintain control. For control of fruit diseases, begin applications at flowering.
A rate of 6.5 fl. oz./acre may be used for preventative applications before onset of visible disease, in periods of low disease pressure, or in a tank mix with other fungicides for resistance management. Otherwise, use a rate of 13.0 fl. oz./acre.		

CROP CROUP 19: HERBS AND SPICES †: **Allspice, angelica, anise, anise, star, annatto (seed), balm, basil, borage, burnet, camomile, caper buds, caraway, caraway, black, cardamom, cassia bark, cassia buds, catnip, celery seed, chervil (dried), chive, chive, Chinese, cinnamon, clary, clove buds, coriander leaf (cilantro or Chinese parsley), coriander seed (cilantro), costmary, cilantro (leaf), culantro (seed), cumin, curry (leaf), dill (dillweed), dill (seed), fennel (common), fennel, Florence (seed), fenugreek, grains of paradise, horehound, hyssop, juniper berry, lavender, lemongrass, lovage (leaf), lovage (seed), mace, marigold, marjoram, mustard (seed), nasturtium, nutmeg, parsley (dried), pennyroyal, pepper, black, pepper, white, poppy (seed), rosemary, rue, saffron, sage, savory, summer and winter, sweet bay, tansy, tarragon, thyme, vanilla, wintergreen, woodruff, and wormwood.**		
DISEASES/PATHOGENS	**RATES**	**ADDITIONAL INFORMATION**
Downy mildew (*Peronospora* spp. and others) **Powdery mildew** (*Oidium* spp. and others)	6.5 – 13.0 fl. oz./acre (0.42 – 0.72 oz. a.i./acre) Do not apply more than 2.2 oz. a.i./acre/season (6 appl. at max. rate).	Begin preventive sprays when conditions favor disease development, and continue on a 7-10 day spray interval as needed.

† Not for use in California.
- Product may harm herbs and spices, especially new leaves. Do not apply to herbs and spices without prior testing on a small number of plants.
- A rate of 6.5 fl. oz./acre may be used for preventative applications before onset of visible disease, in periods of low disease pressure, or in a tank mix with other fungicides for resistance management. Otherwise, use a rate of 13.0 fl. oz./acre.

CROP GROUP 24: TROPICAL AND SUBTROPICAL FRUIT, INEDIBLE PEEL: **Bananas and Plantains** ✷		
DISEASES/PATHOGENS	**RATES**	**ADDITIONAL INFORMATION**
Black Sigatoka leaf streak (*Mycosphaerella fijiensis* Morelet) **Yellow Sigatoka leaf spot** (*Mycosphaerella musicola*)	6.5 – 13.0 fl. oz./acre (0.42 – 0.72 oz. a.i./acre) Do not apply more than 4.2 oz. a.i./acre/season (6 appl. at max. rate).	Begin applications when leaves first appear and repeat on a 7-21 day interval or as needed. Apply in sufficient water to obtain thorough coverage of foliage. For improved control, product may be tank- mixed with other fungicides registered for control of Sigatoka at label rates. When conditions are conducive to rapid disease development and/or heavy disease pressure, higher application rates and rotational spray programs with other fungicides registered for control of Sigatoka are recommended.

✷ For use in Hawaii and Puerto Rico only.
A rate of 6.5 fl. oz./acre may be used for preventative applications before onset of visible disease, in periods of low disease pressure, or in a tank mix with other fungicides for resistance management. Otherwise, use a rate of 13.0 fl. oz./acre.

MISCELLANEOUS COMMODITIES (NO CROP GROUP): Artichokes (Chinese and Jerusalem) †		
DISEASES/PATHOGENS	**RATES**	**ADDITIONAL INFORMATION**
Gray mold/Botrytis rot (*Botrytis cinerea*)	6.5 – 13.0 fl. oz./acre (0.42 – 0.72 oz. a.i./acre)	Begin applications at first sign of disease symptoms and repeat on 7-14 day interval as long as conditions favor disease development.
Powdery mildew (*Leveillula taurica, Erysiphe cichoracearum*)	Do not apply more than 4.2 oz. a.i./acre/season (6 appl. at max. rate).	Apply as a foliar spray in sufficient water to achieve thorough coverage of all above- ground plant parts. May also be applied through overhead sprinkler irrigation. See "Chemigation Instructions" for additional information.
A rate of 6.5 fl. oz./acre may be used for preventative applications before onset of visible disease, in periods of low disease pressure, or in a tank mix with other fungicides for resistance management. Otherwise, use a rate of 13.0 fl. oz./acre. † Not for use in California.		

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.

PESTICIDE STORAGE: Store in dry place away from food or feed.

PESTICIDE DISPOSAL: Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.

CONTAINER HANDLING:

[*Containers ≤ 5 gallons:*]

Nonrefillable container. Do not reuse or refill this container. Completely empty container into application equipment. Triple rinse container (or equivalent) promptly after emptying. Triple rinse as follows: Empty the remaining contents into application equipment or a mix tank and drain for 10 seconds after the flow begins to drip. Fill the container ¼ full with water and recap. Shake for 10 seconds. Pour rinsate into application equipment or a mix tank or store rinsate for later use or disposal. Drain for 10 seconds after the flow begins to drip. Repeat this procedure two more times. Then offer for recycling or reconditioning (if available), or puncture and dispose of in a sanitary landfill or by incineration, if allowed by State and local authorities. If burned, stay out of smoke.

[*Containers > 5 gallons:*]

Nonrefillable container. Do not reuse or refill this container. Completely empty container into application equipment. Triple rinse or pressure rinse container (or equivalent) promptly after emptying. *Triple rinse as follows:* Empty the remaining contents into application equipment or a mix tank. Fill the container ¼ full with water. Replace and tighten closures. Tip container on its side and roll it back and forth, ensuring at least one complete revolution, for 30 seconds. Stand the container on its end and tip it back and forth several times. Turn the container over onto its other end and tip it back and forth several times. Empty the rinsate into application equipment or a mix tank or store rinsate for later use or disposal. Repeat this procedure two or more times. *Pressure rinse as follows:* Empty the remaining contents into application equipment or a mix tank and continue to drain for 10 seconds after the flow begins to drip. Hold container upside down over application equipment or mix tank or collect rinsate for later use or disposal. Insert pressure rinsing nozzle in the side of the container, and rinse at about 40 PSI for at least 30 seconds. Drain for 10 seconds after the flow begins to drip. Then offer for recycling or reconditioning (if available), or puncture and dispose of in a sanitary landfill or by incineration, if allowed by State and local authorities. If burned, stay out of smoke.

WARRANTY

Kaken Pharmaceutical Co., Ltd. warrants that the material contained herein conforms to the description on the label and is reasonably fit for the purpose referred to in the directions for use. Timing and method of application, weather, watering practices, nature of soil, the disease problem, condition of the crop, incompatibility with other influencing factors in the use of this product are beyond the control of the seller. Buyer assumes all risks of use, storage, or handling of this material not in strict accordance with directions given herein. TO THE EXTENT CONSISTENT WITH APPLICABLE LAW, NO OTHER EXPRESSED OR IMPLIED WARRANTY OF THE FITNESS OR MERCHANTABILITY IS MADE.

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