United States Department of Agriculture
Agricultural Marketing Service | National Organic Program
Document Cover Sheet
https://www.ams.usda.gov/rules-regulations/organic/petitioned-substances

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 Add Chitosan to the National List of Allowed Substances for Crop Production (7 CFR §205.601)

Submitted by:
Yuan Cheng
Chief Product Officer
Tidal Grow AgriScience
Tidal Vision Products, Inc.

Date of Submission:
July 15, 2025

Tidal Vision Products, Inc.
3710 Iron Gate Road
Bellingham, WA 98226

July 15, 2025

National List Manager
USDA/AMS/NOP, Standards Division
1400 Independence Ave. SW
Room 2648-So., Ag Stop 0268
Washington DC 20250-0268

Dear National Organic Standards Board Members:

Please find attached a petition requesting that chitosan (CAS RN 9012-76-4), also known as poly-D-glucosamine, be added to 7 CFR §205.601(i) as a synthetic substance permitted for use in organic crop production as a pesticide. This petition is submitted by Tidal Vision, the leading U.S. manufacturer of sustainable chitosan solutions. Tidal Vision utilizes a zero-waste, green chemistry process to upcycle crustacean shell byproducts into biodegradable, high-purity chitosan products that are transforming agricultural production.

Chitosan merits inclusion on the National List due to its proven broad-spectrum efficacy and its ability to significantly reduce reliance on copper-based fungicides. Organic growers depend heavily on copper compounds to control critical fungal diseases such as downy mildew, powdery mildew, late blight, walnut blight, citrus canker, and apple scab. Copper is one example of the limited tools currently available to organic producers. Chitosan offers a new, effective option that can be integrated into broader integrated pest management (IPM) programs to improve disease control flexibility and resilience and also reduce grower reliance on copper-based fungicides.

The National Organic Standards Board (NOSB) has recognized the need for effective, lower-impact alternatives as copper's widespread use leads to persistent soil accumulation, disruption of beneficial microbes, and harm to non-target organisms. This need for additional tools was further emphasized in the NOSB's Spring 2025 meeting, which identified "Comprehensive Review of Copper Systems" as a priority research area and an urgency in developing materials and biological controls to reduce copper use where possible.

Recent multi-site field trials in commercial citrus systems demonstrate that chitosan can reduce copper applications by up to 50% without compromising disease control. Such reductions substantially mitigate long-term soil contamination and ecological risks while maintaining crop protection. These results illustrate the important role chitosan can play as part of a diversified disease management approach that alleviates over-reliance on a single input and advances the

NOSB's goal of reducing copper use. Beyond copper reduction, chitosan provides additional agronomic and environmental benefits aligned with organic principles. Chitosan is fully biodegradable, supports beneficial soil microbiota, enhances plant resilience to drought and salinity, and improves seed germination, root development, and yield quality. This multifunctional role as a biostimulant, biopesticide, and soil amendment makes it a valuable tool for organic producers seeking effective, low-residue solutions.

Importantly, chitosan is derived from chitin, a naturally occurring polysaccharide, through the removal of acetyl groups, resulting in a core polymer structure that is endogenous to nature and biodegradable, consistent with organic production standards. On January 9, 2023, the U.S. Environmental Protection Agency finalized a rule adding chitosan to the list of active ingredients exempt from registration under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) Section 25(b) for minimum risk pesticides, following an extensive multi-year scientific review concluding that it poses minimal risk to human health and the environment. This federal determination reinforces chitosan's safety profile and supports its eligibility for inclusion on the National List.

We also wish to emphasize that while chitosan offers a proven pathway to reduce copper use, its approval should not be limited only to such substitution scenarios but should remain broad and inclusive to fully support the diverse agronomic and ecological benefits for organic growers outlined in this petition.

This petition provides substantial new evidence not available during prior NOSB reviews, including recent field trial data, updated regulatory determinations, and the latest peer-reviewed research. We believe inclusion of chitosan will equip organic growers with an urgently needed, scientifically validated tool to improve disease management flexibility, reduce over-reliance on copper, and strengthen the resilience and sustainability of certified organic agriculture.
We appreciate your time and thoughtful consideration.

Respectfully,

Yuan Cheng
Chief Product Officer
Tidal Grow AgriScience
Tidal Vision Products, Inc.

ITEM A

1. National List Category

This petition seeks to add chitosan (CAS RN 9012-76-4) or Poly-D-Glucosamine (names used interchangeably) to 7 CFR§205.601(i) as a synthetic substance allowed for use in organic crop production as a pesticide.

2. OFPA Category

This petition applies to the OFPA category of production aid.

3. Inert Ingredients

This petition does not contain a synthetic inert ingredient for use in pesticide products.

ITEM B

1. Substance Name

Name: Poly-D-glucosamine
Other Names: Chitosan
CAS Registration Number: 9012-76-4

2. Petitioner and Manufacturer Information

Tidal Vision Products, Inc.
3710 Iron Gate Road
Bellingham, WA 98226
(360) 603-7676

3. Intended or Current Use

Chitosan is primarily intended and is currently used as a pesticide in agricultural production. Chitosan acts as a fungicide, a plant elicitor, stimulating natural plant defense mechanisms against a wide range of pathogens, including fungi, bacteria, and viruses, and a biostimulant that enhances plant growth and resilience to abiotic stress.

4. Intended Activities and Application Rate

There are 11 EPA registered agricultural end use products that include the active ingredient chitosan (products containing other actives not approved for use in organic agriculture are excluded). One of these, Biorend Cu, is a dual-active product containing both chitosan and copper sulfate pentahydrate. This product was first registered by the EPA in 2024. There are also at least three 25(b) exempt products on the market. The names and registration numbers of these products are listed in Section 9 of this document, and their labels are attached in Appendix A.

The products are labeled for the following agricultural activities:

- Plant disease control (fungi, bacteria, viruses)
- Plant growth enhancement (root development, nutrient uptake, induced resistance)
- Reduction of transplant shock
- Soil amendment (microbial balance, rhizobacteria support)
- Seed treatment (germination, seedling vigor)
- Post-harvest disease management (fruits, vegetables)

A summary of the crops, application rates, and application methods are described in the table below. The focus of this table is chitosan application rates, but the maximum annual application rate of copper sulfate pentahydrate is 3.45 lbs/acre in citrus crops based on the Biorend CU label.

Crops and Application Quantities

Crop Group	**Application Method(s)**	**Chitosan rate per acre**	**Concentration in solution**	**Frequency**
Fruits (apples, grapes, citrus, berries)	Foliar, Soil drench	500-1,500 mL (0.5-1.5 qt)	0.1–0.5% (1–5 g/L)	7-14 days
Vegetables (tomatoes, potatoes, cucurbits, leafy greens, root crops)	Foliar, Soil drench, In-furrow	500-1,500 mL (0.5-1.5 qt)	0.1–0.5% (1–5 g/L)	7-14 days
Grains/Legumes (wheat, barley, rice, corn, beans, peas, lentils)	Foliar, In-furrow	500-1,500 mL (0.5-1.5 qt)	0.1–0.5% (1–5 g/L)	7-14 days
Oil Seed Crops	Foliar, In-furrow	0.07 mL –45 L (0.001–48 qt)	0.25–30% (25–300 g/L)	7–14 days
Nuts and Tree Crops	Foliar, Soil drench	600 mL –114 L (0.6–120 qt)	1.3–30% (13–300 g/L)	7–14 days
Ornamentals	Foliar, Soil drench	500-1,500 mL (0.5-1.5 qt)	0.1–0.5% (1–5 g/L)	7-14 days
Herbs/Spices	Foliar	500-1,500 mL (0.5-1.5 qt)	0.1–0.5% (1–5 g/L)	7-10 days
Seed Treatment	Seed coating	4 oz/100 lbs seed	-	Once, pre-plant

Additional Use Considerations

Chitosan is most effective when used preventatively or at the first sign of disease. Early and regular foliar applications can help support plant health and reduce the risk of pathogen outbreaks. It primarily acts by eliciting plant defense responses, strengthening cell walls, and inhibiting fungal growth. Chitosan is generally compatible with most fertilizers and pesticides, though a jar test is recommended before tank mixing. Most chitosan products have minimal or no re-entry interval, allowing for flexible application timing.

5. Manufacturing Process

Chitin, the main feedstock for the production of chitosan, is a naturally occurring polysaccharide found in the cell walls of fungi, the exoskeletons of insects, and the shells of crustaceans. Chitosan is formed through the deacetylation of chitin, a process that occurs enzymatically in nature.

Although enzymatic methods exist, commercial production of chitosan predominantly involves chemical processing of crustacean shells, an abundant waste product of the seafood industry. This process typically involves two main steps: (1) isolating chitin by removing proteins and minerals from the shells, and (2) converting the purified chitin into chitosan through chemical deacetylation.

Importantly, the transformation of chitin into chitosan does not involve the synthesis of new polymer backbones or the incorporation of unnatural monomers. Instead, chitosan is derived directly from chitin, a naturally occurring polysaccharide, through the removal of acetyl groups. As such, chitosan retains the fundamental β-(1→4)-linked glucosamine structure found in nature, making it a naturally sourced polymer retaining its native biological structure, even when produced synthetically.

Specific processes vary between manufacturers but frequently involve the following extraction techniques:

Step	**Potential Reagents**	**Conditions**	**Notes**
Deproteinization	NaOH, KOH, $NaNa_2SO_3$, Na_2CO_3	25-100 °C for 30 minutes - 72 hours	The bases listed denature proteins and disrupt cell membranes; NaOH is the most commonly used.
Demineralization	HCl, HNO_3, CH_3COOH, HCOOH	25-100 °C for 30 minutes - 48 hours	Strong or weak acids solubilize calcium carbonate and other minerals.
Deacetylation	NaOH or KOH	80-150 °C for 1 hour - 48 hours	Strong alkali bases remove acetyl groups, converting chitin to chitosan with free amine groups.

*Information in table from Pellis et al. (2022)

While the above processes historically have been the standard, companies are innovating to reduce energy consumption and waste streams, and as a result, cleaner domestic production is increasing. Tidal Vision Products, Inc., the submitter of this petition, has recently initiated full-scale chitosan manufacturing in Washington State, a jurisdiction with some of the most comprehensive environmental regulations in the country. While Tidal Vision's specific manufacturing process is proprietary to protect our intellectual property, we confirm that our process does not generate hazardous waste streams and is designed to operate as a zero-waste system, with all inputs and outputs managed within a closed-loop process.

In accordance with U.S. Environmental Protection Agency (EPA) regulations, facilities are required to evaluate and report hazardous waste generation based on the quantity and characteristics of the waste produced. As defined under the Resource Conservation and Recovery Act (RCRA), only facilities that generate hazardous waste above specified thresholds must submit biennial hazardous waste reports to the EPA (40 CFR § 262.41, 42 U.S.C. § 6922(a)(6)). Tidal Vision has conducted the appropriate evaluations and confirms that our process does not trigger hazardous waste reporting requirements under federal law.

Consumer demand, technological advancement, and increasingly stringent environmental regulations are also driving advancement in chitosan production in other parts of the world. For example, China, the largest global producer of chitosan, has implemented ongoing environmental regulations aimed at reducing industrial pollution (Zhu et al., 2024). Additionally, China is developing the upcoming Environmental and Ecology Code, expected to be enacted in 2026, which will impose further emission reductions on manufacturers.

It is also important to note that chitosan production, regardless of the specific manufacturing method, relies on industrial upcycling to convert crustacean shell waste into a valuable biopolymer. Shells from shrimp, crab, and other crustacean processing are often low-value by-products that might otherwise be landfilled, incinerated, or discarded at sea, practices associated with environmental harm. Using these shells for chitosan production upcycles this waste into a high-value, biodegradable biopolymer suitable for agricultural and other applications, supporting resource efficiency and waste reduction. This upcycling process supports waste reduction, improves resource efficiency, and reduces the environmental footprint of the seafood industry.

6. Ancillary Substances

Organic acids including acetic acid, citric acid, lactic acid or malic acid, formic acid, and others allow chitosan to dissolve in water. Each of these acids is included among allowed items on the National List and are used in concentrations milder than household vinegar.

7. Previous Reviews

Multiple petitions related to the chitosan (CAS RN: 9012-76-4) have been submitted to the NOSB. All petitions are summarized in the table below.

Petition Date	Scope	Use	Outcome	Notes
January 2004	Crops	Pesticidal Inert Ingredient (adjuvant)	Added to the national list as an adjuvant	Chitosan is also present on EPA List 4
October 2019	Crops	Plant Disease Control	The committee did not recommend inclusion on the national list.	*Discussion of committee concerns below
June 2020	Crops	Production Aid	Petition determined Insufficient	
June 2020	Handling/ Livestock	Livestock Feed Additive	Petition determined Insufficient	
December 2024	Handling	Processing Aid in Wine Production	Still under NOSB review	

In 2019, a petition was submitted to the National Organic Standards Board (NOSB) requesting the inclusion of chitosan on the National List as a synthetic substance allowed in organic crop production for plant disease control. While the Board acknowledged that chitosan is a benign and low-risk substance, it ultimately did not recommend its inclusion, despite a divided vote. The Board's concerns focused primarily on the manufacturing process, and members expressed uncertainty about the necessity of the product within organic systems at that time.

Since the Board voted on the petition in 2021, there has been substantial new research highlighting chitosan's potential as an effective fungicide in organic agriculture when used as part of an IPM program. In particular, new field research conducted in 2024/25 demonstrates the ability to reduce metallic copper loads by 50% while increasing protection from pathogens like citrus canker. Notably, the EPA has also approved a dual-active fungicide containing both chitosan and copper sulfate pentahydrate, with maximum copper application rates significantly lower than those of traditional copper products. Given the well-documented environmental impacts of copper, both in terms of use and production, we respectfully request that the Board reconsider chitosan's inclusion on the National List in light of the updated information and supporting data provided in this petition. The addition of chitosan for plant disease control would equip organic growers with a new tool and greater flexibility in IPM options while simultaneously reducing the over reliance on copper.

8. Regulatory Authority

Chitosan was first registered as a pesticide active ingredient with the U.S. Environmental Protection Agency (EPA) on December 2, 1980. Currently, multiple chitosan-based end-use agricultural products remain registered with the EPA. The corresponding EPA registration

numbers are provided under Item 9 of this document, and the EPA-stamped master labels for these products are included in Appendix A.

On January 9, 2023, the EPA finalized a rule adding chitosan (CAS Reg. No. 9012-76-4) to the list of active ingredients eligible for exemption from registration under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) Section 25(b) for minimum risk pesticides (40 CFR 152.25(f)) (Docket ID #: EPA-HQ-OPP-2019-0701). This action followed an extensive multi-year review, during which the EPA concluded that chitosan poses minimal risk to human health and the environment.

Additionally, chitosan is exempt from the requirement of a tolerance under 40 CFR 180.1072 when used as a pesticide, including seed treatment or application to raw agricultural commodities. This exemption confirms that residues from chitosan used in this manner are permitted and do not require a formal tolerance limit.

The intended use of chitosan described in this petition, as a pesticide, is consistent with the use patterns described in the EPA registered product labels, the uses allowed by the 25(b) minimum risk exemption, and the scope of the tolerance exemption.

As this petition pertains only to pesticidal uses of chitosan, FDA registration and approval is not applicable.

9. Chemical Abstracts Service (CAS) Number and Product Labels

The substance chitosan is assigned to CAS No. 9012-76-4.

The following list contains all registered agricultural end use products that include the active ingredient chitosan (products containing other actives not approved for use organic agriculture are excluded):

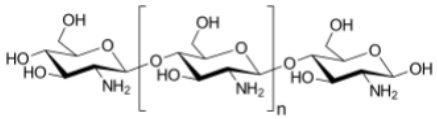
1. GENMAX (EPA Reg. No. 93966-1)
2. Armour-Zen (EPA Reg. No.75747-3)
3. Armour-Zen (EPA Reg. No.75747-5)
4. ELEXA 4 (EPA Reg. No.81045-2)
5. BioRend (EPA Reg. No.91664-1)
6. NUPRO (EPA Reg. No.91664-3)
7. Biorend Cu (EPA Reg. No.91664-4)
8. Exceed SAR Plus (EPA Reg. No.91967-1)
9. NEMASAN (EPA Reg. No.92032-1)
10. Chitocide, also marketed as BioAid-Nematicide (EPA Reg. No.95653-2)
11. KitoGreen (EPA Reg. No. 99270-1)
12. Tidal Grow Spectra (25(b) exempt product)
13. Warhammer (25(b) exempt product)
14. Impact SIX (25(b) exempt product)

The currently registered EPA master labels can be found in Appendix A of this petition.

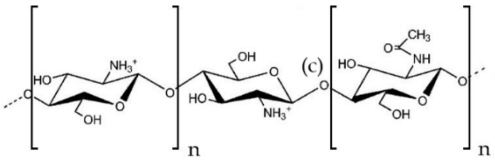
10. Physical and Chemical Properties

Basic Physical and Chemical Properties

Chitosan

Property	**Value**
Structure	 **Figure 1. Structure of Chitosan** (EPA 2020)
Physical State	Solid flake or powder
Color	White to off-white
Odor	None
Solubility	Insoluble in neutral or basic water, Soluble in slightly acidic water or dilute acid
Molecular Weight	Variable but typically 10-1000 kDa
Degree of Deacetylation	>75%, will depend on manufacturer

Chitosan dissolved in acetic acid

Property	**Value**
Structure	 (Nexight Group 2020)
Physical State	Liquid
Color	Clear to Amber
Odor	Slight Vinegar Odor
pH	Typically, 3-5, will depend on manufacturer
Density	1.000-1.250 g/ml, variable based on product concentration
Viscosity	1-50,000 cP, variable based on product concentration

Chemical interactions with other substances

Chitosan is a cationic polysaccharide, and its charge plays a central role in its interactions with other substances. In solution, chitosan's protonated amine groups readily interact with negatively charged molecules, surfaces, or ions, such as humic acids, proteins, microbial cell walls, and certain minerals. This makes chitosan highly effective as a coagulant and flocculant.

Due to this binding capacity, chitosan may form complexes or precipitates when mixed with other negatively charged substances. As is standard practice, compatibility testing is recommended prior to blending or tank mixing.

Chitosan has also demonstrated complimentary interaction properties when combined with certain materials. For example, chitosan used in combination with copper applied at half the rate of standard treatment has demonstrated comparative disease control to full application rates of the standard copper treatment (Lemke et al., 2022; Romanazzi et al. 2016; Romanazzi et al., 2021; Romanazzi et al., 2024; TGA Citrus Canker Study 2025, Appendix G). While the mode of action of this complimentary interaction is not completely understood, Lemke et al. (2022) hypothesize that chitosan may destabilize fungal cell walls, thereby enhancing copper ion uptake.

Toxicity and environmental persistence

Chitosan was reviewed by the U.S. EPA in 2020 and again in 2022 during the agency's evaluation of its eligibility for listing as a minimum risk pesticide under 40 CFR 152.25(f) (U.S. EPA, 2020 included as Appendix B; U.S. EPA, 2022 included as Appendix C). The reviews concluded that chitosan poses minimal risk to human health, non-target organisms (including aquatic species), and the environment. Key findings include:

Toxicity:

- Classified as Toxicity Category IV for all acute toxicity endpoints (oral, dermal, inhalation, eye, and skin), the lowest concern level under EPA guidelines.
- Not a skin sensitizer.
- No genotoxic, mutagenic, or carcinogenic concerns.
- No adverse effects were reported at dietary exposures up to 5,200 mg/kg/day in 6-month Sprague Dawley rat studies.
- Widespread exposure through food, supplements, and medical products without patterns of adverse effects.
- No reported incidents in EPA's human health or ecological incident databases related to chitosan pesticide products.
- While chitosan salts showed moderate toxicity to aquatic organisms in laboratory studies, the EPA concluded that adverse effects to aquatic species are not anticipated based on exposure modeling and toxicity effects data.

Environmental Persistence:

- Chitosan is readily biodegradable in soil, as demonstrated by multiple peer-reviewed studies cited by the EPA.
- Based on the use patterns of chitosan, persistence in aquatic environments is expected to be low.
- Soil studies suggest that chitosan is rapidly degraded by soil microbes.

Additionally, as part of its Safer Choice program, EPA added both chitosan and chitosan acetate to the Safer Chemical Ingredients List (SCIL) at the program's highest confidence level (green circle designation). To make this determination, EPA conducted an extensive review of each substance's potential impacts on human health and the environment, including carcinogenicity, reproductive and developmental toxicity, toxicity to aquatic life and environmental persistence and bioaccumulation. This designation further supports the conclusion that chitosan and its derivatives present minimal risk under expected use conditions.

Environmental impacts from its use and/or manufacture

As discussed in the previous section, chitosan is generally recognized to have minimal environmental impacts when used in agricultural settings. Notably, its use has been shown to reduce the need for more persistent or toxic inputs, such as copper-based pesticides.

Chitosan manufacturing also presents significant environmental advantages. As described in the manufacturing section of this petition, increasing demand from consumers for "green" products, technological advancements, and stricter environmental regulations are driving the development of cleaner production processes. Additionally, chitosan production upcycles waste from the seafood industry into a valuable, biodegradable input for agriculture. This process helps divert marine processing waste from disposal routes that can harm ecosystems.

Globally, approximately 8 million tons of crustacean shell byproduct are generated each year (Popović, et al. 2023). These shells are most often treated as waste and either dumped at sea or sent to landfills. When dumped into marine environments, they may contribute to oxygen depletion, smother benthic organisms, and introduce disease or invasive species (U.S. Environmental Protection Agency, 2023). Landfilled shells can reduce available capacity, generate odors, and result in pathogen proliferation. Chitosan manufacturing offers a viable and sustainable alternative by valorizing this material.

Finally, chitosan offers the potential to reduce reliance on copper, a non-renewable resource extracted through mining. Copper mining is associated with ecosystem disruption, hazardous waste generation, air pollution, and high energy use. If chitosan use is able to reduce copper use in organic systems, it would represent a net environmental benefit by reducing pressure on mined resources and lowering the overall ecological footprint of pest and disease control strategies.

Effects on human health

Chitosan-based pesticides are not expected to have negative impacts on human health when used as directed. The U.S. Environmental Protection Agency has classified chitosan as a minimum risk pesticide, determining it poses no concern to human health when used as a pesticide. This safety assessment is supported by chitosan's established safety record across multiple applications, including drinking water treatment coagulants, beverage fining agents, and medical devices. Additionally, glucosamine, a derivative of chitosan, is commonly consumed as a dietary supplement, further demonstrating the compound's safety profile for human exposure.

Effects on soil organisms, crops, or livestock

Chitosan poses minimal risk to soil organisms, crops, or livestock.

Research indicates that chitosan has generally beneficial or neutral effects on soil microbial communities. Specifically, studies have shown that chitosan can have positive impacts on soil microflora populations (Shibana et al., 2024) and can increase soil stability (Wang et al., 2025).

In plants, chitosan is recognized as a biostimulant that can promote plant growth and increase resistance to abiotic stressors such as drought and salinity. These effects contribute to overall plant health.

Additionally, Chitosan demonstrates very low toxicity to animals and has a well-established safety profile for livestock use. It is even permitted as a feed additive at levels up to 0.1% (Association of American Feed Control Officials, 2024). No adverse effects on animal health have been identified when chitosan is used as directed in agricultural applications.

11. Safety Information

Please refer to Appendix D for the SDS of chitosan flake and Appendix E for the SDS of GENMAX, an EPA approved chitosan pesticide product.

The National Toxicology Program (NTP) Technical Report on the Toxicity Study of Chitosan is attached as Appendix F.

12. Research Information

Chitosan is a well-studied biopolymer with a substantial and growing body of scientific literature supporting its pesticidal, plant defense-eliciting, and biostimulant properties. As the NOSB has previously reviewed chitosan, this section highlights recent research developments that may not have been fully considered in earlier evaluations, particularly its capacity to reduce reliance on copper-based materials and its complementary interactions with microbial biocontrol agents such as *Pochonia chlamydosporia*. No substantial research was identified presenting contrasting positions that question chitosan's safety or efficacy within organic systems.

Recent Advances in Chitosan's Direct Pesticidal Activity

Direct Fungicidal Activity

Chitosan's direct antifungal properties are one of the better known and studied uses of chitosan in agriculture, with most of the foundational research occurring prior to the NOSB's previous review of this material. However, a comprehensive 2023 review by Shcherban provides an updated synthesis of chitosan's demonstrated broad-spectrum efficacy against fungi and other pathogens.

Shcherban (2023) compiles extensive research demonstrating chitosan's broad-spectrum antifungal efficacy across a wide range of crops and fungal pathogens, including *Botrytis*, *Alternaria*, *Fusarium*, *Colletotrichum*, *Sclerotinia*, and *Rhizoctonia*. Chitosan inhibits multiple stages of fungal development such as spore germination, mycelial growth, and sporulation through direct mechanisms like cell wall disruption, membrane destabilization, and nutrient chelation. Additionally, it activates plant immune responses, including salicylic and jasmonic acid pathways, ROS generation, and the induction of defense-related enzymes and structural

barriers. The review also presents data on formulation enhancements—such as chemical modifications and complementary combinations (e.g., with salicylic, succinic, or glutamic acid) for improved efficacy.

Complementing this broader review, a 2025 study by Torres-Rodriguez et al. provides experimental evidence of chitosan's ability to induce systemic resistance in tomato plants infected with *Fusarium oxysporum*. In this study, foliar application chitosan applied at a rate of 3 g/L reduced *F. solani* incidence significantly compared to the untreated control and the Carbendazim fungicide treatment, and the chitosan treatment reduced disease severity at a similar rate to the fungicide treatment. Interestingly, *F. solani* inoculated tomato plants treated with 2 g/L and 3 g/L chitosan had greater plant height, root biomass, and root length than plants treated with Carbendazim fungicide. The findings support chitosan's dual role as both a direct antifungal agent and a potent plant elicitor.

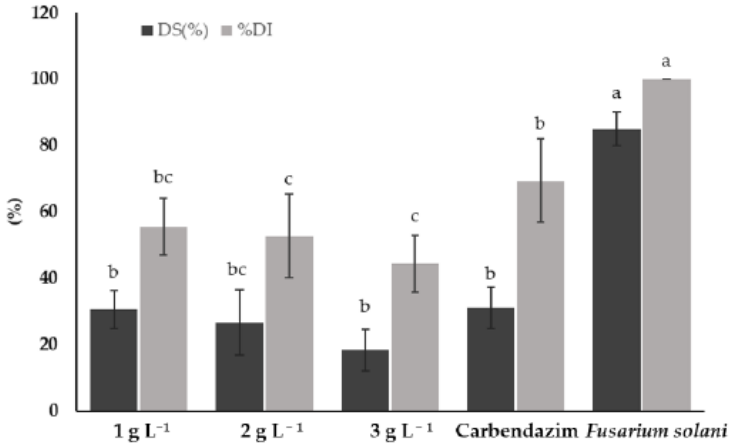


Figure 4. Disease severity (DS) and disease incidence (DI) caused by *Fusarium solani* on tomato plants treated with chitosan. Means with the same letters do not differ significantly ($p < 0.05$) according to Tukey's test. Data are presented as the mean ± standard deviation of six replicates (six tomato plants per treatment).

Figure reproduced from Torres-Rodriguez et al. (2025), "Biocontrol of Fusarium solani: Antifungal Activity of Chitosan and Induction of Defence Enzymes" Plants, *14*(3), 431. https://doi.org/10.3390/plants14030431. Licensed under CC BY.

Another recent study by Piancatelli et al. (2025) evaluated natural compounds, including chitosan, in a two-year field trial targeting grapevine downy and powdery mildew. A 0.5% chitosan treatment reduced the McKinney index for downy mildew on leaves by up to 94% and for powdery mildew by 98%, achieving disease control comparable to copper-based standards. These findings further support chitosan's fungicidal efficacy in high disease pressure field conditions.

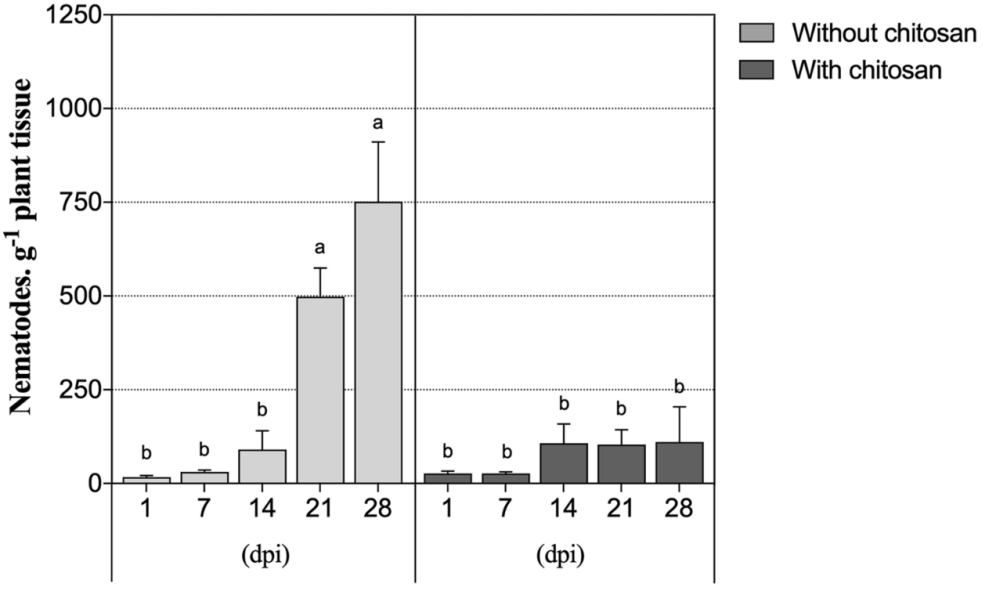
Nematode Control Efficacy

Plant parasitic nematodes such as root-knot nematodes (RKN, *Meloidogyne* spp.) are among the most damaging and difficult-to-manage pests in organic systems. Because curative chemical nematicides are generally prohibited in organic agriculture, control strategies rely heavily on cultural practices such as crop rotation, cover cropping, and solarization. However, these approaches are often inconsistent, limited by site-specific variables, and rarely effective once an

infection is established (Krueger and McSorely, 2008). Recent research has highlighted chitosan as a promising organic-compatible tool for RKN management, with both direct and plant-mediated modes of action.

In a controlled greenhouse study, Özdemir et al. (2023) evaluated soil, foliar, and combined soil+foliar applications of 1% chitosan on tomato plants infected with *Meloidogyne incognita*. The combined application resulted in a 62% reduction in gall index and a 64% reduction in egg mass index compared to untreated controls, performing statistically on par with the synthetic nematicide Fluopyram. Soil-only and foliar-only treatments were moderately effective but less so than the combined approach, suggesting that targeting both root and foliar tissues enhances efficacy. The authors suggest that foliar applications are effective due to chitosans ability to trigger plant systemic resistance.

In a controlled growth chamber study, Silva et al. (2021) evaluated the effects of low-molecular-weight chitosan (327 kDa) on *Pinus pinaster* seedlings inoculated with the pinewood nematode *Bursaphelenchus xylophilus*. After 28 days, chitosan-treated plants exhibited a sixfold reduction in nematode populations in stem tissues compared to untreated controls. This suppression was associated with significant physiological and molecular changes indicative of induced plant defenses. Specifically, chitosan treatment led to increased catalase activity, higher levels of total phenolic compounds, lignin, and anthocyanins, as well as the upregulation of the defense-related gene DEF (defensin). The authors concluded that the observed population reduction was linked to the enhancement of the plant's defenses through metabolic and transcriptomic mechanisms. These findings support the role of chitosan as a plant defense elicitor, reinforcing its potential utility as a biological input in organic systems.



Nematode population in plant tissues. Nematode density in *P. pinaster* stem tissues 1, 7, 14, 21 and 28 days post-inoculation (dpi). Plants were inoculated with the pinewood nematode (PWN) *B. xylophilus* 14 days following the application of 0.5% acetic acid (without chitosan, non-elicited controls) or a chitosan solution to plants' substrate. Data represents the difference between the averages of PWN-inoculated and water-inoculated plants ± SE, and different letters indicate statistically different means at $P < 0.05$.

Figure reproduced from Silva et al. (2021), "Chitosan increases Pinus pinaster tolerance to the pinewood nematode (Bursaphelenchus xylophilus) by promoting plant antioxidative metabolism. Scientific Reports, 11(1), 3781". Licensed under CC BY.

Insecticidal Properties and Mechanisms

Chitosan's potential as an insecticide is an emerging area of research, with growing interest in its applications for pest management. Two recent reviews document chitosan's demonstrated insecticidal, antifeedant, and oviposition-deterrent activity across a range of insect pests in both in vitro and in vivo settings. Proposed modes of action include physical interference with feeding or respiration, disruption of gut microbiota, and use as a carrier to enhance delivery of essential oils or insecticides.

Bhuva et al. (2025) summarized chitosan's insecticidal and antifeedant activity against several economically important pests relevant to organic systems. They report that in a leaf-dip bioassay using a 3.0 g/L chitosan solution, *Helicoverpa armigera* (corn earworm) showed 40% mortality, *Plutella xylostella* (diamondback moth) 72%, and *Rhopalosiphum padi* (bird cherry-oat aphid) 93% mortality after 72 hours (citing Zhang et al., 2003). The review also notes antifeedant effects against *Aphis glycines* (soybean aphid). Proposed mechanisms include midgut disruption, induction of chitosanase activity, and formation of a surface film that may impede respiration. They also suggest that chitosan's efficacy is enhanced when formulated with essential oils, metal ions, or biopesticides such as spinosad.

Abenaim and Conti (2023) similarly reviewed evidence of chitosan's insecticidal effects through gut disruption and interference with microbial symbionts. For example, they cite studies in which a 2% chitosan solution incorporated into artificial diets significantly reduced survival in *Musca domestica* (housefly), *Tabanus nigrovittatus* (greenhead horsefly), and *Phormia regina* (black blow fly), with lifespans reduced by up to 80%.

Complementary Interactions with other Actives

Chitosan as a Copper Reduction Strategy

Copper-based fungicides have long been a cornerstone of disease management in organic and conventional agriculture due to their broad-spectrum efficacy. However, repeated copper applications can result in the accumulation of heavy metals in soil, leading to concerns about soil health, water quality, and potential toxicity to non-target organisms. Regulatory agencies and the National Organic Standards Board (NOSB) have highlighted the need for alternatives or strategies that reduce copper inputs, aligning with organic principles of environmental stewardship and sustainability. Recent studies suggest that integrating chitosan into disease management programs can enable approximately a 50% reduction in copper use without compromising efficacy.

Recent field research conducted by Tidal Grow AgriScience, a division of Tidal Vision, provides multi-site evidence supporting the efficacy of Tidal Grow Spectra, a 25(b)-exempt, chitosan-based pesticide, when used in combination with Kocide, a copper hydroxide fungicide, in commercial citrus production (Appendix G). Key target pathogens included *Xanthomonas citri* (citrus canker), *Phytophthora* spp., *Septoria citri*, and *Colletotrichum gloeosporioides* (anthracnose), all of which contribute to premature fruit drop, foliar decline, and reduced marketable yield in high-value citrus production. In this field study, a tank mix of reduced-rate (50%) Kocide and Spectra provided statistically significant improvements in disease control and fruit drop reduction compared to the untreated control and, in most cases, to the full-rate copper standard.

While not statistically significant in this trial due to site variability, sites treated with the tank mix of reduced-rate Kocide and Spectra showed a 17% direction increase in yield compared to the full-rate Kocide grower standard program. Importantly, this performance was achieved with a 50% reduction in metallic copper use, resulting in an estimated $11/acre cost savings and $125/acre potential revenue gain, supporting both economic and environmental benefits. No phytotoxicity was observed, and soil copper levels remained stable.

Other recent studies support this finding by Tidal Grow AgriScience. Lemke et al. (2022) demonstrated that partial hydrolysis of chitosan polymers to produce low molecular weight fractions led to enhanced antifungal activity. When combined with copper acetate, these hydrolyzed chitosans acted complimentary, maintaining full antifungal efficacy with only half the copper concentration. This suggests that chitosan–copper formulations can improve disease control while reducing total copper inputs, addressing both efficacy and environmental concerns.

Romanazzi et al. (2021) evaluated chitosan alone and in combination with copper hydroxide across five years of field trials targeting grapevine downy mildew. A 0.5–0.8% chitosan formulation provided effective control both on its own and when combined with 50% reduced-rate copper. The chitosan–copper mix significantly reduced disease incidence, severity, and the McKinney index, even during seasons of high disease pressure. A follow-up study by Romanazzi et al. (2024) extended field trials on grapevine downy mildew for an additional three years and confirmed the efficacy of integrating chitosan with reduced copper inputs. A 0.25% chitosan treatment combined with half the labeled dose of copper oxychloride outperformed the full-rate copper standard in disease control. The study also evaluated postharvest copper residues on berries, finding that all chitosan-based strategies, including chitosan alone, sequential copper and chitosan applications which reduced seasonal copper applications, and tank mixes with reduced-rate copper, significantly lowered copper residues compared to the standard copper program.

In a greenhouse study evaluating treatments for cucumber powdery mildew (CPM), Kim et al. (2024) found that a combination of chitosan and oxidated copper salt provided one of the most effective disease suppression outcomes. This treatment achieved an 85.7% control value in the first evaluation and maintained high efficacy (61.3%) in the second, with diseased leaf area remaining below 2% throughout. Compared to other inorganic, biological, and essential oil-based treatments, the chitosan–copper combination ranked among the top-performing options for sustained CPM control. These results reinforce chitosan's value in integrated disease management strategies and its compatibility with reduced-copper formulations.

Together, these findings strengthen the case for incorporating chitosan into disease management strategies as a means to reduce copper inputs while maintaining or enhancing disease control efficacy across multiple crop systems.

Chitosan Complimentary Interaction with Pochonia chlamydosporia for Nematode Control

A 2021 study by Suarez-Fernandez et al looked at the molecular mechanisms contributing to chitosans ability to enhance the plant parasitic nematode control by the biocontrol fungus *Pochonia chlamydosporia.* In addition to being nematophagous, *P. chlamydosporia* is a chitosan resistant fungus and has mechanisms to efficiently degrade chitosan The study revealed that *P. chlamydosporia* responds to chitosan exposure by altering its gene expression, notably:

- Activating pathways that mitigate chitosan-induced oxidative stress, particularly through the regulation of reactive oxygen species related genes.
- Upregulating chitosan-degrading enzymes, including chitosanases, which convert chitosan into utilizable sugars.
- Enhancing the expression of transporters and metabolic enzymes to internalize and catabolize these sugars.

These chitosan-induced changes were shown to amplify multiple biological processes and molecular functions within the fungus, many of which are directly associated with nematode egg parasitism. The authors hypothesize that chitosan acts as a molecular cue, priming *P. chlamydosporia* for more efficient nematode egg attachment, penetration, and degradation, thereby improving its biocontrol potential.

Taken together, these studies demonstrate that chitosan is a rigorously validated, multi-functional input that delivers consistent and measurable benefits across diverse pest and disease management challenges. Chitosan proven efficacy, compatibility with biological control agents, and ability to reduce reliance on more intensive chemical inputs make it a valuable tool aligned with organic agriculture's principles of sustainability and integrated management.

13. Petition Justification Statement

Inclusion of Chitosan, a Synthetic, on the National List 7 CFR §205.601(j)(4) as a synthetic substance permitted for use in organic crop production as a pesticide.

Necessity of Chitosan for Organic Agriculture

Chitosan merits inclusion on the National List of allowed substances for use in organic crop production due to its scientifically validated broad-spectrum efficacy, its multifunctional agronomic benefits, and its essential role in reducing reliance on copper-based fungicides.

Organic growers today depend heavily on copper compounds to control a range of high-impact diseases—including downy mildew (*Peronospora* spp.), powdery mildew, walnut blight, citrus canker, late blight (*Phytophthora infestans*), and apple scab—because copper remains one of the few effective and approved options under current organic standards. However, this reliance comes at a growing environmental cost, and the need for safe, effective alternatives has become increasingly urgent, as recognized in the NOSB's Spring 2025 priority research agenda identifying "Comprehensive Review of Copper Systems" and the development of biologically based substitutes as critical areas of focus.

The well-documented ecological risks of copper include:

- Soil health degradation: Copper is a non-degradable element that accumulates over time. Elevated copper concentrations disrupt beneficial soil microbial communities, impair nutrient cycling, and ultimately reduce soil fertility.
- Toxicity to non-target invertebrates: Excess copper is lethal to beneficial soil organisms such as earthworms, which play indispensable roles in aeration and decomposition.

- Pollinator impacts: Though not directly insecticidal, copper's sublethal effects on pollinators—including honeybees and solitary bees—have been observed, posing an indirect threat to agricultural productivity.

Since the Board's previous vote in 2021, new field research and updated EPA approvals have further demonstrated chitosan's capacity to reduce copper use by up to 50% while maintaining or improving disease control as part of an integrated pest management program (TGA Citrus Canker Study 2025, Appendix G). Chitosan's ability to reduce 50% copper use offers a viable pathway to mitigate soil contamination and ecological damage while preserving crop protection standards essential to organic systems. Moreover, adoption of chitosan can help U.S. producers proactively address emerging regulatory restrictions on copper that are already taking effect in the European Union and other markets.

Beyond copper reduction, chitosan delivers a suite of agronomic and environmental benefits fully consistent with organic principles. As a naturally structured, biodegradable compound, chitosan:

- Supports beneficial soil microbiota, thereby improving soil health and fertility over time
- Enhances plant resilience to abiotic stressors such as drought, salinity, and heavy metals
- Promotes seed germination, root development, and yield quality while reducing residues on harvested crops and protecting pollinators
- Aligns with the organic mandate to prioritize ecological balance and minimize synthetic residues

Chitosan, a derivative of naturally occurring chitin that can be synthesized on an industrial scale, has become increasingly recognized as an important input in agriculture, uniquely suited to address the challenges of organic production—including escalating pest resistance, climate variability, and the demand for sustainable crop protection tools.

Key reasons for the indispensability of chitosan in organic agriculture include the following:

- Broad-spectrum efficacy: Chitosan protects against diverse plant pathogens—fungi, bacteria, nematodes, and insects—while simultaneously activating systemic acquired resistance in crops.
- Abiotic stress mitigation: Chitosan strengthens plant tolerance to environmental extremes, helping producers maintain yields under increasingly unpredictable conditions (Bittelli et al 2001; Farouk et al 2020).
- Soil and ecosystem health: Chitosan is fully biodegradable, does not accumulate as a pollutant, and supports beneficial microbial communities essential to healthy organic systems (Malerba 2018).
- Regulatory validation of safety: On January 9, 2023, the U.S. Environmental Protection Agency formally exempted chitosan under FIFRA Section 25(b), confirming its minimal risk profile and reinforcing its suitability for organic production.
- Compatibility with organic principles: Chitosan embodies the core objectives of the Organic Foods Production Act to maintain and improve natural resources and ecological balance.

Alternatives to Chitosan

Alternative	Efficacy vs. Disease	Environmental Impact	Practicality/Limitations
Cultural practices	Low-moderate	Positive	Insufficient under high pressure
Biologicals	Variable	Positive	Inconsistent, crop-specific
Copper fungicides (full rate)	High	Negative	Heavy metal accumulation
Other synthetics	Variable	Variable	Phytotoxicity, limited efficacy
Chitosan (alone or combo)	High	Positive	Broad-spectrum, low residue

Nonsynthetic Substances: While cultural practices (crop rotation, sanitation, resistant varieties) and biologicals (*Bacillus* spp. *Trichoderma*, etc.) are foundational to organic systems, they have repeatedly proven insufficient for robust disease and pest control, especially under high pressure or in the face of evolving pest resistance.

Synthetic Substances on the National List: Copper fungicides remain essential in organic systems but are associated with environmental persistence and regulatory restrictions due to soil accumulation and potential toxicity. Other allowed synthetics, such as hydrogen peroxide, have limited efficacy and may cause phytotoxicity or require frequent application.

Alternative Cultural Methods: Physical exclusion and strict hygiene can reduce disease spread but are not practical or sufficient as standalone measures in most commercial organic operations.

Beneficial Effects of Chitosan Use

The environmental benefits of chitosan adoption are substantial. By enabling significant reductions in copper and other synthetic inputs, chitosan directly mitigates risks of soil and water contamination. Chitosan's biodegradability ensures that no persistent residues accumulate in the environment, thereby sustaining long-term soil health (Bhattacharya et al. 2012; Malerba et al., 2018). Chitosan amendments also improve soil structure, moisture retention, and beneficial microbial populations.

Chitosan’s benefits go beyond crop protection. Crops treated with chitosan consistently exhibit lower synthetic residues, benefiting consumers and farmworkers alike. Furthermore, chitosan’s minimal environmental persistence reduces risks to non-target insects, arthropods, and wildlife critical to ecosystem balance.

Economically, chitosan offers clear returns. By promoting seed germination, root development, and overall plant vigor, chitosan improves yields and crop quality. Its postharvest benefits

include delayed ripening and less microbial spoilage, reducing losses and improving marketable output, supporting grower profitability (Romanazzi et al. 2017).

Justification in the Context of the National List Criteria

Chitosan addresses pressing challenges in organic agriculture, including pest resistance, climate stress, and the need for sustainable, low-residue crop protection tools. Chitosan's inclusion on the National List directly supports the NOSB's goals in reducing reliance on persistent inputs and protecting ecosystem health. As a sustainable, effective, and economically viable solution to the most pressing challenges in organic production, chitosan aligns with the organic sector's commitment to minimizing synthetic inputs, safeguarding natural resources, and maintaining long-term productivity. Chitosan's addition to the National List is justified by its proven capacity to improve disease management flexibility, strengthen soil health, reduce dependence on copper-based fungicides, and advance the sustainability, resilience, and integrity of certified organic agriculture.

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Appendix A - Chitosan Product EPA Master Labels

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF CHEMICAL SAFETY
AND POLLUTION PREVENTION

January 13, 2016

Amy Plato Roberts
Regulatory Consultant for Botry Zen (2010) Limited
Technology Sciences Group
712 FIFTH STREET, SUITE A
DAVIS, CA 95616

Subject: Non-PRIA (Pesticide Registration Improvement Act) Labeling Amendment – Replace File Symbol with EPA Reg. No and add marketing statement to PRODUCT INFO section, Page 4.
Product Name: Armour-Zen
EPA Registration Number: 75747-3
Application Date: June 15, 2015
OPP Decision Number: 512814

Dear Ms. Roberts:

In an application dated 6/15/15 (OPP Decision No. 506180), you notified the U.S. Environmental Protection Agency (EPA) that you replaced the EPA File Symbol with the EPA Registration Number and added a marketing statement to the Product Information section under the Directions for Use (Page 4 of the product label). Subsequently, the EPA determined that the action requested did not fall under the scope of Pesticide Registration Notice 98-10 and therefore converted the notification to a minor label amendment (OPP Decision No. 512814).

The amended labeling referred to above, submitted in connection with registration under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), as amended, is acceptable.

This approval does not affect any terms or conditions that were previously imposed on this registration. You continue to be subject to existing terms or conditions on your registration and any deadlines connected with them.

A stamped copy of your labeling is enclosed for your records. This labeling supersedes all previously accepted labeling. You must submit one (1) copy of the final printed labeling before you release this product for shipment with the new labeling. In accordance with 40 CFR § 152.130(c), you may distribute or sell this product under the previously approved labeling for 18 months from the date of this letter. After 18 months, you may only distribute or sell this product if it bears this new revised labeling or subsequently approved labeling. “To distribute or sell” is defined under FIFRA section 2(gg) and its implementing regulation at 40 CFR § 152.3.

Should you wish to add/retain a reference to your company's website on your label, then please be aware that the website becomes labeling under FIFRA and is subject to review by the EPA. If the website is false or misleading, the product will be considered to be misbranded and sale or distribution of the product is unlawful under FIFRA section 12(a)(1)(E). 40 CFR § 156.10(a)(5) lists examples of statements the EPA may consider false or misleading. In addition, regardless of whether a website is referenced on your product's label, claims made on the website may not substantially differ from those claims approved through the registration process. Therefore, should the EPA find or if it is brought to our attention that a website contains false or misleading statements or claims substantially differing from the EPA-approved registration, the website will be referred to the EPA's Office of Enforcement and Compliance Assurance.

Your release for shipment of this product constitutes acceptance of these terms. If these terms are not complied with, this registration will be subject to cancellation in accordance with FIFRA section 6.

If you have any questions, please contact Sandra Owusu-Ansah of my team by phone at (703) 347-0350 or via email at owusu-ansah.sandra@epa.gov.

Sincerely,

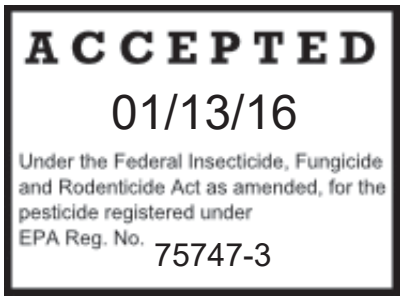
Andrew Bryceland, Team Leader
Biochemical Pesticides Branch
Biopesticides and Pollution
Prevention Division (7511P)
Office of Pesticide Programs

Enclosure

ARMOUR-Zen®

MASTER LABEL, containing:
Sublabel A: Greenhouse and Field Use
Sublabel B: Home & Garden Use

EPA Reg. No.: 75747-3



Sublabel A: Greenhouse and Field Use

ARMOUR-Zen®

ACTIVE INGREDIENT:
Chitosan 30.00%
OTHER INGREDIENTS: 70.00%
TOTAL: 100.00%

Product contains 2.5 lb (1134 g) of chitosan per gallon.

KEEP OUT OF REACH OF CHILDREN
CAUTION

FIRST AID	
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 treatment advice.
HOTLINE NUMBER Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-800-222-1222 for emergency medical treatment information.	

See (back) (side) panel for additional precautionary statements and directions for use.

EPA Reg. No.: 75747-3
EPA Establishment No.: XXXXX-XX-XX
(**Batch No. / Lot No.:** XXX)

Net Weight: XX lbs (XX kg)

Manufactured by:
Botry-Zen (2010) Limited
156 Frederick Street, P.O. Box 1777
Dunedin 9054
New Zealand
www.botryzen.co.nz

Distributed by:
(U.S. name and address –to be determined)

PRECAUTIONARY STATEMENTS

Hazards to Humans and Domestic Animals - CAUTION. Causes moderate eye irritation. Avoid contact with eyes. Wear safety glasses or goggles. 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.

Personal Protective Equipment (PPE): Applicators and other handlers must wear long-sleeved shirt and long pants, waterproof gloves, and shoes plus socks. Follow the manufacturer's instructions for cleaning / maintaining PPE. If no such instructions for washables exist, use detergent and hot water. Keep and wash PPE separately from other laundry.

User Safety Recommendations: Users should remove clothing/PPE immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing. Users should 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: Do not apply directly to water, or to areas where surface water is present, or to intertidal areas below the mean highwater mark. Do not contaminate water when disposing of equipment washwater or rinsate.

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 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 the label about personal protective equipment (PPE), and restricted entry interval (REI). 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 hour.

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, waterproof gloves, shoes plus socks.

Exception: If the product is soil-injected or soil-incorporated, the Worker Protection Standard, under certain circumstances, allows workers to enter the treated area if there will be no contact with anything that has been treated.

Product Information: ARMOUR-Zen is chitosan-based product that is antifungal and antibacterial, preventing spore germination and causing existing mycelia to shrink and lose structural integrity. ARMOUR-Zen is effective against plant pathogens, soil and foliar diseases including powdery and downy mildews, *Botrytis, Phytophthora* spp., leaf spot, early and late blight, anthracnose, stem wilt, damp-off, stem cankering and blast. ARMOUR-Zen can be used throughout the growing season in greenhouse and field applications.

(**Integrated Pest Management:** Integrating ARMOUR-Zen into an overall pest management strategy and following best management practices (or practices known to reduce disease development) makes it less likely that disease will be established. Specific IPM strategies developed for your crop and location may be available from the Extension Service or other local agricultural authorities.)

Mixing and Application Instructions:

MIXING: Dilute ARMOUR-Zen with water and apply in conventional spray equipment or through sprinkler irrigation. Partially fill the spray tank with clean water and begin agitation. Add the specified amount of ARMOUR-Zen to the tank. Finish filling the tank to the desired volume to obtain the proper spray concentration. Use spray mixture immediately. Do not allow spray mixture to stand overnight or for prolonged periods.

APPLICATION: Apply ARMOUR-Zen using conventional spray equipment to the point of saturation. Good coverage and wetting is required. The amount of spray solution to apply will vary depending on the type of crop. Most row crops will require up to 100 gallons of spray per acre. Apply in sufficient water to achieve thorough coverage.

COMPATIBILITY: ARMOUR-Zen may be tank mixed with some fungicides. Do not tank mix ARMOUR-Zen with more than one product. Consult specific product labels for additional information or restrictions concerning tank mixing. Observe the most restrictive of the labeling limitations and precautions of all products used in mixtures. It is always advisable to conduct a spray compatibility test when you plan to mix this product with another product. To determine the physical compatibility of this product with other products, use a jar test. Using a quart jar, add the proportionate amounts of the products to approximately one quart of water with agitation. Add dry formulations first, then flowables, and then emulsifiable concentrates 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 procedure for adding products to the spray tank.

ARMOUR-Zen has been evaluated for phytotoxicity on a variety of crops under various normal growing conditions. However, testing all crop varieties, in all mixtures and combinations is not feasible. Prior to treating entire crop, test a small portion of the crop for sensitivity.

Foliar Applications:

ARMOUR-Zen can be applied as a foliar spray by ground and by air. Mix 1 – 4 quarts in 100 gallons of water and apply at a sufficient spray volume to ensure complete coverage. The optimum concentration for most uses is 2 quarts per 100 gallons of water.

Soil Treatment Use Directions:

ARMOUR-Zen can be applied by soil drench, in-furrow spray, or soil injection to improve plant health and to protect against certain soil-borne diseases.

In general, ARMOUR-Zen can be applied by the following methods, unless specified differently in the SELECTED CROPS section:

Soil Drench Applications

Apply ARMOUR-Zen at a concentration of 1 – 4 quarts per 100 gallons of water, and at a sufficient rate to thoroughly soak the growing media and root zone. Make an initial application during or shortly after transplant to control soil-borne diseases, reduce transplant shock, induce disease resistance, and to promote root growth. Multiple drench applications can be made on a 10 – 14 day schedule.

Shanked-In and Injected Applications

ARMOUR-Zen can be shanked or injected into the soil alone, or with most types of liquid nutrients.

In-Furrow Applications

ARMOUR-Zen can be applied at planting as an in-furrow spray. Mix 1 – 4 quarts of ARMOUR-Zen® in 100 gallons of water and apply at 5 – 15 gallons per acre, directing the spray into the seed furrow just before the seeds are covered.

Application Rates for Selected Crops:

ARMOUR-Zen used as specified will prevent, control and suppress a broad range of plant diseases, as well as induce the natural defense system of the treated plants listed below.

The general recommendation is to apply 1 – 4 quarts per 100 gallons of water. The optimum concentration for most applications is 2 quarts per 100 gallons of water.

Application Rates for Foliar Spray:

Crops	Target Disease	Application Method	Use Rate per 100 Gallons	Notes
Artichoke	Powdery Mildew (*Erysiphe cichoracearum*) (*Leveillula taurica*) Ramularia Leaf Spot (*Ramularia cynarae)*	Foliar (Ground)	1 – 4 quarts	For ground applications, apply in 50 – 100 gallons of water per acre. Apply this product preventatively or at the first sign of disease symptoms are visible. Reapply every 7 – 14 days.
		Foliar (Aerial)	1 – 4 quarts	For aerial applications, apply this product in a minimum of 5 gallons of water per acre. Apply preventatively or when the first disease symptoms are visible and apply every 7 – 14 days.
		Chemigation	1 – 4 quarts	Apply through irrigation immediately after transplant and at 14- day intervals or begin 14 days after transplant when soil drench applications are used.
Asparagus	Botrytis Blight (*Botrytis cinerea*) Rust (*Puccinia aspargi*)	Foliar (Ground)	1 – 4 quarts	For ground applications, apply this product in 50 – 100 gallons of water per acre. Apply preventatively or when the first disease symptoms are visible and apply every 7 – 14 days.
		Foliar (Aerial)	1 – 4 quarts	For aerial applications, apply this product in a minimum of 5 gallons of water per acre. Apply preventatively or when the first disease symptoms are visible and apply every 7 – 14 days.
Berries, including: Blackberry Blueberry Bushberry Caneberry Cranberry Currants Elderberry Gooseberry Huckleberry Loganberry Raspberry	Botrytis Blight (*Botrytis cinerea*) Mummy Berry (*Monilinia vaccinii-corymbosi*) Alternaria Fruit Rot (*Alternaria* spp.) Anthracnose Fruit Rot (*Colletotrichum acutatum*) Bacterial Canker (*Pseudomonas syringae*) Leaf Rust (*Pucciniastrum vaccinii*)	Foliar (Ground)	1 – 4 quarts	Apply in 50 – 100 gallons per acre. Mummy Berry – Begin applications at bud break stage of development. Apply preventatively and repeat on a 7 -10 cay interval or as needed. Botrytis Blight – Apply this product preventatively prior to or at first sign of disease symptoms. Reapply every 7 – 14 days or as needed. Bacterial Canker – Apply prior to Fall rains and repeat applications during dormancy before Spring growth. This product can be tank mixed with another registered fungicide for improved control of bacterial canker. Anthracnose Fruit Rot and Alternaria Fruit Rot on blueberries – Apply at green tip and continue on a 7 – 10

				interval.
	Leaf Spot and Blotch (*Mycosphaerella* spp.) (*Septoria* spp.) Phomopsis Leaf Spot, Twig Blight and Fruit Rot (*Phomopsis* spp.) Powdery Mildew (*Microsphaera alni*) Spur Blight (*Didymella* spp.) (*Phoma* spp.)	Foliar (Aerial)	1 – 4 quarts	For aerial applications, apply this product in a minimum of 5 gallons of water per acre.
Bulb Vegetables, including: Garlic Leeks Onions (Bulb and Green) Shallots And other bulb vegetable crops	Botrytis Leaf Blight (*Botrytis squamosa*) Botrytis Neck Rot (*Botrytis* spp.) Onion Purple Blotch (*Alternaria* porri) Downy Mildew (*Peronospora* spp.) Powdery Mildew (*Erysiphe* spp.) Rust (*Puccinia porri*) Stemphyllium Leaf Blight (*Stemphylium vesicarium*)	Foliar	1 – 4 quarts	Apply preventively in 50 – 100 gallons of water per acre. Repeat applications at 7 – 14 day intervals.
	Fusarium spp. *Pythium* spp. *Rhizoctonia* spp.	Soil Drench	1 – 4 quarts	Apply at a concentration of 1 – 4 quarts per 100 gallons of water, thoroughly soaking the growing media and root zone. Apply during or shortly after transplant to reduce transplant shock, suppress soilborne disease and improve root growth. Multiple drench applications can be made on a 10 – 14 day interval.
		In-Furrow	1 – 4 quarts	Apply as an in-furrow spray at planting at the rate of 1 – 4 quarts per 100 gallons of water. Apply in 5 – 15 gallons of water and direct the spray into the seed furrow just before the seeds are covered.
		Plant Dip	1 – 4 quarts	Apply as a 0.5 – 2% suspension (1 – 4 quarts per 100 gallons) as a pre-plant dip immediately prior to transplant.
		Chemigation	1 – 4 quarts	Apply through irrigation immediately after transplant and at 14- day intervals or begin 14 days after transplant when soil drench applications are used.

Cereal Grains, including: Barley Buckwheat Grain Amaranth Milo Oat Millets Rice Rye Sorghum Triticale Wheat	Powdery Mildew (*Erysiphe graminis*) Bacterial Blight and Streak (*Xanthomonas* spp.) Brown Rot, Leaf Spots & Smuts (*Ceratobasidium* spp.) (*Cercospora* spp.) (*Drechslera* spp.) Rice Blast (*Pyricularia grisea*) Rust (*Puccinia* spp.) Septoria Leaf Spot (*Septoria* spp.) Sheath Spot and Blight (*Rhizoctonia oryzae*) (*Thanatephorus cucumeris*) Stem Rot (*Sclerotium oryzae*) Smut (*Tilletia barclayana*)	Foliar (Ground)	1 – 4 quarts	To optimize disease control and to maximize yields, apply in 15 – 40 gallons of water per acre. Apply preventatively or when disease symptoms first appear. Repeat applications on a 7 – 14 day interval depending upon crop growth and disease pressure. When plants are under high disease pressure, tank mix this product with another registered fungicide for more effective control.
		Foliar (Aerial)	1 – 4 quarts	For aerial applications, apply this product in a minimum of 5 gallons of water per acre. Apply preventatively or at the first sign of disease symptoms. Repeat applications at 7 – 14 day intervals.
Citrus Fruits, including: Calamondin Citrus citron Citrus hybrids Grapefruit Kumquat Lemon Lime Mandarin Orange, sour and sweet Pummelo Satsuma mandarin	Bacterial Canker (*Xanthomonas* spp.) Alternaria Brown Spot (*Alternaria alternata*) Bacterial Blast (*Pseudomonas syringae*) Black Spot (*Guignardia citricarpa*) (*Phyllosticta citricarpa*) Greasy Spot (*Mycosphaerella citri*) Melanose (*Diaporthe citri*) Postbloom Fruit Drop (*Colletotrichum acutatum*) Scab (*Elsinoe australis*) (*Elsinoe fawcetti*)	Foliar (Ground)	1 – 4 quarts	Apply in 50 – 100 gallons per acre. Begin application when conditions are conducive to disease development. Repeat on 7 to 10 day intervals or as needed.
		Foliar (Arial)	1 – 4 quarts	For aerial applications, apply this product in a minimum of 5 gallons of water per acre. Apply preventatively or at the first sign of disease symptoms. Repeat applications at 7 – 14 day intervals.
Cole Crops	Powdery Mildew (*Erysiphe cruciferarum*)	Foliar (Ground)	1 – 4 quarts	Apply in 50 – 100 gallons per acre.

(Brassicas), including: Broccoli Broccoli Rabe Brussels Sprouts Cabbage Chinese Broccoli Chinese Cabbage (Bok Choy) Chinese Cabbage (Napa) Chinese Mustard Cabbage (Gai Choy) Cauliflower Cavalo Collards Kale Kohlrabi Mizuna Mustard Greens Mustard Spinach Rape Greens Turnip	(*Erysiphe polygoni*) Alternaria Leaf Spot (*Alternaria* spp.) Downy Mildew (*Peronospora parasitica*) Pin Rot Complex (*Alternaria, Xanthomonas*) Xanthomonas Leaf Spot (*Xanthomonas campestris*)			Begin application when conditions are conducive to disease development. Repeat on 7 to 10 day intervals or as needed.
		Foliar (Arial)	1 – 4 quarts	For aerial applications, apply this product in a minimum of 5 gallons of water per acre. Apply preventatively or at the first sign of disease symptoms. Repeat applications at 7 – 14 day intervals.
Corn, including: Sweet Corn Field Corn Popcorn Silage Corn Seed Corn	Anthracnose Leaf Blight (*Colletotrichum graminicola*) Eye Spot (*Aureobasidium zeae*) Gray Leafspot (*Cercospora zeae-maydis*) Rusts (*Puccinia* spp.) Northern Leaf Blight (*Cochiliobus carbonum*) Southern Leaf Blight (*Cochiliobus heterostrophus*)	Foliar (Ground)	1 – 4 quarts	Apply in 15 – 40 gallons per acre. Begin application when conditions are conducive to disease development. Repeat on 7 to 10 day intervals or as needed.
		Foliar (Arial)	1 – 4 quarts	For aerial applications, apply this product in a minimum of 3 gallons of water per acre. Apply preventatively or at the first sign of disease symptoms. Repeat applications at 7 – 14 day intervals.
Cotton	Alternaria Leaf Spot, Boll Rot (*Alternaria* spp.) Anthracnose, Boll Rot (*Anthracnose* spp.) Ascochyta Blight, Boll Rot (*Ascochyta* spp.) Cercospora Blight and Leaf Spot (*Cercospora* spp.) Diplodia Boll Rot (*Diplodia* spp.) Hard Lock, Boll Rot	Foliar (Ground)	1 – 4 quarts	Apply in 15 – 40 gallons per acre. Begin application when conditions are conducive to disease development. Repeat on 7 to 10 day intervals or as needed.
		Foliar (Arial)	1 – 4 quarts	For aerial applications, apply this product in a minimum of 3 gallons of water per acre. Apply preventatively or at the first sign of disease symptoms. Repeat applications at 7 – 14 day intervals.

	(*Fusarium* spp.) Leaf Spot (Corynespora cassicola) Phoma Blight, Boll Rot (*Phoma* spp.) Rust (*Puccinia* spp.) (*Phykopsora* spp.) Stemphyllium Leaf Spot (*Stemphyllium* spp.)			
Cucurbits **Includes all types and hybrids of:** Chayote Chinese Waxgourd Cucumber Citron Melon Gherkin Pumpkin Watermelon **Edible Gourd:** Chinese Okra Cucuzza Hyotan ***Mormordica* spp.** Balsam Apple Balsam Pear Bitter Melon Chinese Cucumber **Muskmelon:** Cantaloupe Casaba Crenshaw Melon Golden Pershaw Melon Honeydew Melon Honey Balls Mango Melon Persian Melon Pineapple Melon Santa Clause Melon Snake Melon **Summer Squash:** Crookneck Squash Scallop Squash Straightneck Squash Vegetable Marrow Zucchini **Winter Squash:** Acorn Squash	Powdery Mildew (*Erysiphe cichoracearum*) (*Sphaerotheca fuliginea*) Anthracnose (*Colletotrichum lagenarium*) Alternaria Leaf Spot (*Cercospora citrulina*) Downy Mildew (*Pseudoperonospora cubensis*) Gummy Stem Blight (*Didymella bryoniae*) Phytophthora Blight (*Phytophthora capsici*)	Foliar (Ground)	1 – 4 quarts	Apply preventatively in 25 – 100 gallons of water per acre or at first sign of disease symptoms. Increase water volume as plant size increases. Reapply on a 7 -14 day interval depending on plant growth and disease pressure. Use shorter spray intervals for greenhouse cucurbits when under high disease pressure.
		Foliar (Aerial)	1 – 4 quarts	For aerial applications, apply this product in a minimum of 5 gallons of water per acre. Apply preventatively or at the first sign of disease symptoms. Repeat applications at 7 – 14 day intervals.
	Fusarium spp. *Phytophthora* spp. *Pythium* spp. *Rhizoctonia* spp.	Soil Drench	1 – 4 quarts	Apply at a concentration of 1 – 4 quarts per 100 gallons of water, thoroughly soaking the growing media and root zone. Apply during or shortly after transplant to reduce transplant shock, suppress soilborne disease and improve root growth. Multiple drench applications can be made on a 10 – 14 day interval.
		In-Furrow	1 – 4 quarts	Apply as an in-furrow spray at planting at the rate of 1 – 4 quarts per 100 gallons of water. Apply in 5 – 15 gallons of water and direct the spray into the seed furrow just before the seeds are covered.
		Plant Dip	1 – 4 quarts	Apply as a 0.5 – 2% suspension (1 – 4 quarts per 100 gallons) as a pre-plant dip immediately prior to transplant.
		Chemigation	1 – 4 quarts	Apply through irrigation immediately after transplant and at 14 day intervals or begin 14 days after transplant when soil drench applications are used.

Butternut Squash Calabaza Gubbard Squash Spaghetti Squash And other cucurbit crops				
Fruiting Vegetables, including: Eggplant Okra Pepper Tomato Tomatillo Ground Cherry	Bacterial Blight (*Xanthomonas* spp.) Bacterial Spot (*Xanthomonas* spp.) Bacterial Speck (*Pseudomonas syringae*) Black Mold (*Alternaria alternata*) Early Blight (*Alternaria solani*) Gray Mold (*Botrytis cinerea*) Late Blight (*Phytophthora capsici*) Powdery Mildew (*Erysiphe* spp.) (*Leveillula taurica*) (*Oidopsis taurica*) (*Sphaerotheca* spp.) Target Spot (*Corynespora cassiicola*)	Foliar (Ground)	1 – 4 quarts	Apply preventatively in 25 – 100 gallons of water per acre or at first sign of disease symptoms. Increase water volume as plant size increases. Reapply on a 7 - 10 day interval depending on plant growth and disease pressure. Use shorter spray intervals for greenhouse cucurbits when under high disease pressure.
		Foliar (Arial)	1 – 4 quarts	For aerial applications, apply this product in a minimum of 3 gallons of water per acre. Apply preventatively or at the first sign of disease symptoms. Repeat applications at 7 – 10 day intervals.
	Fusarium spp. *Phytopthora* spp. *Rhizoctonia* spp. *Verticllium* spp.	Soil Drench	. 1 – 4 quarts	Apply at a concentration of 1 – 4 quarts per 100 gallons of water, thoroughly soaking the growing media and root zone. Apply during or shortly after transplant to reduce transplant shock, suppress soilborne disease and improve root growth. Multiple drench applications can be made on a 10 – 14 day interval.
		In-Furrow	1 – 4 quarts	Apply as an in-furrow spray at planting at the rate of 1 – 4 quarts per 100 gallons of water. Apply in 5 – 15 gallons of water and direct the spray into the seed furrow just before the seeds are covered.
		Plant Dip	1 – 4 quarts	Apply as a 0.5 – 2% suspension (1 – 4 quarts per 100 gallons) as a pre-plant dip immediately prior to transplant.

		Chemigation	1 – 4 quarts	Apply through irrigation immediately after transplant and at 14- day intervals or begin 14 days after transplant if soil drench applications are used.
Grapes	Powdery Mildew (*Uncinula necator*) Angular Leaf Spot (*Mycosphaerella angulata*) Anthracnose (*Elsinoe ampelina*) Botrytis Bunch Rot (*Botrytis cinerea)* Black Rot (*Guignardia bidwellii*) Downy Mildew (*Plasmopara viticola*) Eutypa (*Eutypa lata*) Leaf Blight (*Pseudocercospora vitis*) Phomopsis Fruit Rot (*Phomopsis viticola*) Ripe Rot (*Colletotrichum gloeosporioides*) Sour Rot (*Alternaria tenuis*) (*Aspergillus* spp.) (*Botrytis cinerea*) (*Cladosporium herbarum*) (*Penicillium* spp.) (*Rhizopus arrhizus*)	Foliar	1 – 4 quarts	Apply preventively in 50 – 100 gallons of water per acre or the first signs of disease symptoms. Repeat applications at 7 – 14 day intervals depending on crop growth and disease pressure. .
Grass Seed	Powdery Mildew (*Erysiphe gramminis*) (*Oidium* spp.) (*Podosphaera* spp.) (*Sphaerotheca* spp.) Rust (*Puccinia* spp.)	Foliar (Ground)	1 – 4 quarts	Apply preventatively in 25 – 100 gallons of water per acre when disease symptoms are first visible or when environmental conditions are conducive to rapid disease development. Reapply on a 7-day interval or as needed.
Hops	Downy Mildew (*Pseudoperonosperora humili*)	Foliar (Ground)	1 – 4 quarts	Apply preventatively in 50 – 100 gallons of water or when environmental conditions are conducive to rapid disease development. Reapply on a 7-

	Powdery Mildew (*Sphaerotheca macularis*)			day interval or as needed.
Leafy Vegetables, including: Arugula Beet Celery Chervil Cilantro Corn Salad Cress Dandelion Dock Edible Chrysanthemum Endive Fennel Garden Peas Head Lettuce Leaf Lettuce Parsley Purslane Radicchio Rhubarb Spinach Swiss Chard Watercress	Downy Mildew (*Bremia lactuca*) (*Peronospora* spp.) Bacterial Blight/Rot (*Xanthomonas* spp.) Cercospora Leafspot (*Cercospora* spp.) Late Blight (*Septoria apiicola*) Pink Rot (*Sclerotinia sclerotiorum*) Powdery Mildew (*Erysiphe cichoracearum*) Sclerotinia Had and Leaf Drop (*Sclerotinia minor*) (*Sclerotinia sclerotiorum*) White Rust (*Albugo occidentalis*)	Foliar (Ground)	1 – 4 quarts	Apply preventatively in 50 – 100 gallons of water or when environmental conditions are conducive to rapid disease development. Reapply on a 7-14 day interval or as needed. For concentrated ground applications, apply this product at 0.5 – 1 quart per acre in a minimum of 10 gallons of water per acre.
		In-Furrow	1 – 4 quarts	Apply as an in-furrow spray at planting at the rate of 1 – 2 quarts per acre or 2.2 – 4.4 fluid ounces per 1000 feet of row. Apply in 5 – 15 gallons of water and direct the spray into the seed furrow just before the seeds are covered.
Legumes, succulent and dried, (not including soybeans and peanuts)**:** Chick Peas Dry Beans Garbanzo Beans Green Beans Lentils Lima Beans Peas Shell Beans Snap Beans Split Peas And other legume crops	Bacterial Blight (*Xanthomonas campestris*) Gray Mold (*Botrytis cinerea*) Pythium (aerial blight phase) (*Pythium* spp.) Powdery Mildew (*Erysiphe* spp.) Rust (*Puccinia* spp.) (*Uromyces appendiculatus*) White Mold (*Sclerotinia sclerotiorum*)	Foliar (Ground)	1 – 4 quarts	Apply preventatively in 50 – 100 gallons of water or when environmental conditions are conducive to rapid disease development. Reapply on a 7-day interval or as needed.

	Fusarium spp. *Phytophthora* spp. *Pythium* spp. *Rhizoctonia* spp.	In-Furrow	1 – 4 quarts	Apply as an in-furrow spray at planting at the rate of 1 – 2 quarts per acre or 2.2 – 4.4 fluid ounces per 1000 feet of row. Apply in 5 – 15 gallons of water and direct the spray into the seed furrow just before the seeds are covered.
Mint and other Herbs/Spices, including: Angelica Balm Basil Borage Burnet Chamomile Catnip Chervil Chive Clary Coriander Costmary Cilantro Curry Dillweed Horehound Hyssop Lavender Lemongrass Lovage Marjoram Nasturtium Parsley (dried) Peppermint Rosemary Sage Savory (summer and winter) Sweet Bay Tansy Tarragon Thyme Wintergreen Woodruff Wormwood	Downy Mildew (*Peronospora* spp.) Powdery Mildew (*Erysiphe* spp.) Rust (*Puccinia menthae*)	Foliar (Ground)	1 – 4 quarts	Apply preventatively in 50 – 100 gallons of water per acre or at first sign of disease symptoms. Reapply on a 7 - 10 day interval depending on plant growth and disease pressure.
		Foliar (Arial)	1 – 4 quarts	For aerial applications, apply this product in a minimum of 5 gallons of water per acre. Apply preventatively or at the first sign of disease symptoms. Repeat applications at 7 – 10 day intervals.
Oil Seed Crops, including: Canola Castor Flax Rapeseed Safflower	Bacterial Pustule (*Xanthomonas* spp.) Bacterial Speck (*Pseudomonas syringe pv. glycinea*) Brown Spot	Foliar (Ground)	1 – 4 quarts	To optimize disease control and maximize yields, apply this product preventatively in 15 – 40 gallons of water per acre. Consult your local Extension Specialist or Crop Consultant regarding the optimum timing of fungicide applications.

Sesame Sunflower (does not include cotton, peanut or soybean)	(*Septoria glycines*) Cercospora Leaf Spot (*Cercospora* spp.) Downy Mildew (*Peronospora mansherica*) Pod and Stem Blight (*Diaporthe phaseolorum* var. *sojae*) (*Phomopsis longicola*) White Mold/Sclerotinia Stem Rot (*Sclerotinia sclerotiorum*)	Foliar (Arial)	1 – 4 quarts	For aerial applications, apply this product in a minimum of 3 gallons of water per acre. Consult your local Extension Specialist or Crop Consultant regarding the optimum timing of fungicide applications.
Olive	Olive Knot (*Pseudomonas savastanoi*)	Foliar	1 – 4 quarts	Apply preventatively in 50 – 100 gallons of water per acre. Repeat application at 7 – 14 day intervals or as needed.
Ornamental Plants **Herbaceous Ornamentals** Flowering Plants Foliage Plants **Woody Ornamentals** Broadleaves, Shrubs and trees Conifers, Shrubs and trees	Anthracnose (*Colletotrichum* spp.) Bacteria (*Erwinia* spp.) (*Pseudomonas* spp.) (*Xanthomonas* spp.) Black Spot of Rose (*Diplocarpon rosae*) Blossom Blight (*Monilinia* spp.) Downy Mildew (*Peronospora* spp.) (*Plasmopara viburni*) Gray Mold (*Botrytis cinerea)* Leaf Spot (*Alternaria* spp.) (*Cercospora* spp.) (*Entomosporium* spp.) (*Myrothecium* spp.) (*Septoria* spp.) Powdery Mildew (*Erysiphe* spp.) (*Oidium* spp.) (*Podosphaera* spp.) (*Sphaerotheca* spp.) Rust (*Puccinia* spp.) Scab	Foliar	1 – 4 quarts	Apply preventatively in 50 – 100 gallons of water and repeat on 7 – 14 day intervals, or as needed. This product may be used to control certain diseases of container, bench, flat, plug, bed, or field-grown ornamentals in greenhouses, shade houses, outdoor nurseries, retail nurseries, and other landscape areas.

	(*Venturia* spp.)			
	Fusarium spp. *Phytophthora* spp. *Pythium* spp. *Rhizoctonia* spp. *Verticillium* spp.	Soil Drench	1 – 4 quarts	Apply at a concentration of 1 – 4 quarts per 100 gallons of water, thoroughly soaking the growing media and root zone. Apply during or shortly after transplant to reduce transplant shock, suppress soilborne disease and improve root growth. Multiple drench applications can be made on a 10 – 14 day interval.
		Plant Dip	1 – 4 quarts	Apply as a 0.5 – 2% suspension (1 – 4 quarts per 100 gallons) as a pre-plant dip immediately prior to transplant.
		Chemigation	1 – 4 quarts	Apply through irrigation immediately after transplant and at 14- day intervals or begin 14 days after transplant if soil drench applications are used.
Since it is not possible to test all ornamental species or varieties grown, test Armour-Zen on a few plants prior to large-scale usage.				
Peanut	Aspergillus Crown Rot (*Aspergillus niger*) Rhizoctonia Foliar Blight, Peg, and Root Rot (*Rhizoctonia solani*) White Mold (*Sclerotium rolfsii*)	Foliar	1 – 4 quarts	Apply preventatively in 50 – 100 gallons of water and repeat on 7 – 14 day intervals, or as needed.
	Aspergillus Crown Rot (*Aspergillus niger*) *Fusarium* spp. *Phytophthora* spp. *Pythium* spp. *Rhizoctonia* spp. *Verticillium* spp. White Mold (*Sclerotium rolfsii*)	Soil Drench	1 – 4 quarts	Apply at a concentration of 1 – 4 quarts per 100 gallons of water, thoroughly soaking the growing media and root zone. Apply during or shortly after transplant to reduce transplant shock, suppress soilborne disease and improve root growth. Multiple drench applications can be made on a 10 – 14 day interval.
		In-Furrow	1 – 4 quarts	Apply as an in-furrow spray at planting at the rate of 1 – 2 quarts per acre or 2.2 – 4.4 fluid ounces per 1000 feet of row. Apply in 5 – 15 gallons of water and direct the spray into the seed furrow just before the seeds are covered.
Pome Fruits, including: Apple Crabapple Loquat Mayhaw Pear	Powdery Mildew (*Podosphaera leucotricha*) Alternaria Blotch (*Alternaria mali*) Apple Scab (*Venturia*	Foliar	1 – 4 quarts	Apply in 50 – 100 gallons of water per acre. Begin applications when conditions are conducive to disease development. Repeat applications on 3 – 10 day intervals or as needed. Use high label rate and shorter spray intervals when conditions are conducive to rapid disease

Pear, oriental Quince	*inaequalis*) Bitter Rot (*Colletotrichum* spp.) Black Rot/ Frogeye Leaf Spot (*Botryosphaeria obtusa*) Bot Rot (*Botryosphaeria dothidea*) Brooks Spot (*Mycosphaerella pomi*) Bull's Eye Rot (*Neofabraea* spp.) Cedar-Apple Rust (*Gymnosporangium juniper-virginianae*) Fire Blight (*Erwinia amylovora*) Flyspeck (*Zygophiala jamaicensis*) Sooty Blotch (*Geastrumia polystigmati*) Leptodontium elatius) (*Peltaster fructicola*) White Rot (*Botryosphaeria dothidea*)			development.
Root, Tuber and Corm Vegetables, including: Beets Carrots Cassava Ginger Ginseng Horseradish Potato Radish Sugar beets Sweet potato Yams Turnip	Bacterial Leaf Blight (*Xanthomonas campestris*) Black Root Rot / Black Crown Rot (*Alternaria* spp.) Downy Mildew (*Peronospora* spp.) Early Blight (*Alternaria* spp.) Gray Mold (*Botrytis cinerea)* Late Blight (*Phytophthora infestans*) Powdery Mildew	Foliar	1 – 4 quarts	Apply preventatively in 25 – 100 gallons of water and repeat on 5 – 10 day intervals, or as needed. Begin applications soon after emergence or transplant and when conditions are conducive to disease development. Use higher rates and shorter intervals when conditions favor rapid disease development.
		Soil Drench	1 – 4 quarts	Apply at a concentration of 1 – 4 quarts per 100 gallons of water, thoroughly soaking the growing media and root zone. Apply during or shortly after transplant to reduce transplant shock, suppress soilborne disease and improve root growth. Multiple drench applications can be made on a 10 – 14 day interval.
		In-Furrow	1 – 4 quarts	Apply as an in-furrow spray at planting at the rate of 1 – 2 quarts per acre or 2.2 – 4.4 fluid ounces per 1000 feet of

	(*Erysiphe* spp.) White Mold (*Sclerotinia sclerotiorum*) Clubroot (*Plasmodiophora brassicae*) Common Scab (*Streptomyces scabies*) *Fusarium* spp. *Phytopthora* spp. *Pythium* spp. *Rhizoctonia* spp. *Verticillium* spp.			row. Apply in 5 – 15 gallons of water and direct the spray into the seed furrow just before the seeds are covered.
		Chemigation	1 – 4 quarts	Apply through irrigation immediately after transplant and at 14- day intervals or begin 14 days after transplant if soil drench applications are used.
Soybean	Aerial Web Blight (*Rhizoctonia solani*) Alternaria Leafspot (*Alternaria* spp.) Anthracnose (Colletotrichum truncatum) Asian Soybean Rust (*Phakopsora pachyrhizi*) Brown Spot (*Septoria glycines*) Cercospora Blight (*Cercospora kikuchii*) Frog-eyed Leaf spot (*Cercospora sojina*) Pod and Stem Blight (*Diaporthe* spp.) Septoria Brown Spot (*Septoria glycines*) White Mold (*Sclerotinia sclerotiorum*) .	Foliar (Ground)	1 – 4 quarts	To optimize disease control and maximize yields, apply this product preventatively in 15 – 40 gallons of water per acre. Consult your local Extension Specialist or Crop Consultant regarding the optimum timing of fungicide applications.
		Foliar (Arial)	1 – 4 quarts	For aerial applications, apply this product in a minimum of 3 gallons of water per acre. Consult your local Extension Specialist or Crop Consultant regarding the optimum timing of fungicide applications.

	Fusarium spp. *Phytopthora* spp. *Pythium* spp. *Rhizoctonia* spp	In-Furrow	1 – 4 quarts	Apply as an in-furrow spray at planting at the rate of 1 – 2 quarts per acre or 2.2 – 4.4 fluid ounces per 1000 feet of row. Apply in 5 – 15 gallons of water and direct the spray into the seed furrow just before the seeds are covered.
Stone Fruits, including: Apricot Cherry, sweet and tart Nectarine Peach Plum Plumcot Prune (fresh)	Alternaria Spot/Fruit Rot (*Alternaria alternata*) Anthracnose (*Colletotrichum* spp.) Bacterial Canker (*Pseudomonas* spp.) Bacterial Spot (*Pseudomonas* spp.) Brown Rot Blossom Blight and Fruit Rot (*Monilinia* spp.) Cercospora Leaf Spot (*Cercospora* spp.) Cherry Leaf Rot (*Blumeriella jaapii*) Gray Mold (*Botrytis cinerea*) Jacket Rot, Green Fruit Rot *(Botrytis cinerea, Monilinia* spp.*, Sclerotinia sclerotiorum)* Powdery Mildew (*Podosphaera* spp.) (*Sphaerotheca pannosa*) Rust (*Tranzschelia discolor*) Rusty Spot (*Podosphaera leucotricha*) Scab (*Cladosporium carpophilium*) Shot Hole (*Wilsonomyces carpophilus*)	Foliar	1 – 4 quarts	Apply preventively in 50 – 100 gallons of water when conditions are conducive to disease development. Apply on a 7 – 10 day spray interval or as needed. Bacterial Blight – Apply postharvest before Fall rains. Brown Rot Blossom Blight – Apply at early bloom and repeat on a 7-day schedule through petal fall or as needed. Powdery Mildew – Begin applications at popcorn stage and repeat on a 7-interval or as needed. Scab- Begin applications at petal fall and repeat on a 7 – 10 day interval or as needed.

Strawberry	Anthracnose (*Colletotrichum* spp.) Botrytis (*Botrytis cinerea*) Leaf Spot (*Mycosphaerella fragariae*) Phomopsis Leaf Blight (*Phomopsis obscurans*) Powdery Mildew (*Sphaerotheca macularis*)	Foliar	1 – 4 quarts	Apply preventively in 50 – 100 gallons of water when conditions are conducive to disease development. Apply on a 7 – 10 day spray interval or as needed.
	Black Root Rot (*Rhizoctonia* spp.) (*Pythium* spp.) (*Fusarium* spp.) (*Cylindrocarpon* spp.) Phytophthora Root Rot and Crown Rot (*Phytophthora* spp.) Verticillium Wilt (*Verticillium* spp.) *Fusarium* spp. *Pythium* spp. *Rhizoctonia* spp.	Soil Drench	1 – 4 quarts	Apply at a concentration of 1 – 4 quarts per 100 gallons of water, thoroughly soaking the growing media and root zone. Apply during or shortly after transplant to reduce transplant shock, suppress soilborne disease and improve root growth. Multiple drench applications can be made on a 10 – 14 day interval.
		Plant Dip	1 – 4 quarts	Apply as a 0.5 – 2% suspension (1 – 4 quarts per 100 gallons) as a pre-plant dip immediately prior to transplant.
		Chemigation	1 – 4 quarts	Apply through irrigation immediately after transplant and at 14 - day intervals or begin 14 days after transplant if soil drench applications are used.
Sugar Beets	Powdery Mildew (*Erysiphe betae*) (*Erysiphe polygoni*) Leaf Spot (*Cercospora beticola*) Ramularia (*Ramularia* spp.) Rust (*Uromyces betae*)	Foliar	1 – 4 quarts	Apply preventatively in 15 – 40 gallons of water per acre by ground or air. Consult your local Extension Specialist or Crop Consultant for optimum timing of fungicide applications.
Sugarcane	Brown Rust (*Puccinia melanocephela*) Orange Rust (*Puccinia kuehnii*)	Foliar (Ground)	1 – 4 quarts	Apply preventatively in 15 – 40 gallons of water per acre by ground or air. Consult your local Extension Specialist or Crop Consultant for optimum timing of fungicide applications
		Foliar (Aerial)	1 – 4 quarts	Apply preventatively in a minimum of 3 gallons of water per acre by ground or air. Consult your local Extension Specialist or Crop Consultant for optimum timing of fungicide applications.

Tobacco	Blue Mold (*Peronospora tabacina*)	Foliar	1 – 4 quarts	Apply preventatively in a minimum of 50 gallons of water per acre. Consult your local Extension Specialist or Crop Consultant for optimum timing of fungicide applications.
	Fusarium spp. *Phytophthora* spp. *Pythium* spp. *Rhizoctonia* spp. *Verticillium* spp.	Plant Dip	1 – 4 quarts	Apply as a 0.5 – 2% suspension (1 – 4 quarts per 100 gallons) as a pre-plant dip immediately prior to transplant.
Tree nuts, including: Almond Beech nut Brazil nut Butternut Cashew Chestnut Chinquapin Filbert (hazelnut) Hickory nut Macadamia nut Pecan Walnut, Black and English	Walnut Blight (*Xanthomonas campestris*) Alternaria Late Blight, Alternaria Leaf Spot (*Alternaria spp.*) Anthracnose (*Colletotrichum* spp.) (*Gnomonia leptostyla*) Bacterial Canker (*Erwinia nigrifluens*) Botryosphaeria Blight (*Botryosphaeria dothidea*) Brown Rot (*Monilinia* spp.) Jacket Rot, Green Fruit Rot *(Botrytis cinerea, Monilinia* spp*., Sclerotinia sclerotiorum)* Eastern Filbert Blight (*Anisogramma anomala*) Leaf Rust (*Tranzschelia discolor*) Scab (*Cladosporium carpophilium*) (*Sphaceloma perseae*) Shot Hole (*Wilsonomyces carpophilus*)	Foliar (Ground)	1 – 4 quarts	Apply preventively in 50 – 100 gallons of water when conditions are conducive to disease development. Apply on a 7 – 10 day spray interval or as needed.
		Foliar (Arial)	1 – 4 quarts	For aerial applications, apply this product in a minimum of 10 gallons of water per acre.
Tropical Fruits, including:	Anthracnose (*Colletotrichum gloeosporioides*)	Foliar (Ground)	1 – 4 quarts	Apply preventively in 50 – 100 gallons of water when conditions are conducive to disease development. Apply on a 7

Avocado Banana Kiwi Mango Papaya Plantain Pineapple Pomegranate	Bacterial Blight (*Pseudomonas syringae*) (*Pseudomonas viridiflava*) Bacterial Canker (*Xanthomonas campestris*) Botrytis Fruit Rot (*Botrytis cinerea*) Scab (*Elsinoe mangiferae*) Sigatoka (*Mycosphaerella fijiensis*)			– 10 day spray interval or as needed.
		Foliar (Arial)	1 – 4 quarts	For aerial applications, apply this product in a minimum of 10 gallons of water per acre.

Application Rates for Post-Harvest Commodities:

Postharvest crop	Disease	Rate	Notes
Postharvest fruits and vegetables, including: Apples Cherries Citrus Pears Potatoes Sweet potatoes	Blue mold Dry rot Gray mold Green mold Mucor rot Silver scurf Sour rot	1 – 4 quarts per 100 gallons of water	Apply a single application of a .5 – 2% concentration (1 – 2 quarts per 100 gallons) to achieve good coverage. The application may be made as a spray, a dip or a wash.

CHEMIGATION USE DIRECTIONS

Apply this product only through sprinkler including center pivot, lateral move, end tow, side (wheel) roll, traveler, big gun, solid set, or hand move irrigation systems. Do not apply this product through any other type of irrigation systems. Do not connect an irrigation system (including greenhouse systems) used for pesticide applications to a public water system.

Spray preparation
First prepare a suspension of ARMOUR-Zen in a mix tank. Fill tank ½ to ¾ the desired amount of water. Start mechanical or hydraulic agitation. Add the required amount of ARMOUR-Zen, and then the remaining volume of water. Then set the sprinkler to deliver a minimum of 0.1 to 0.3 inch of water per acre. Start sprinkler and uniformly inject the suspension of ARMOUR-Zen into the irrigation water line so as to deliver the desired rate per acre. Inject the suspension of ARMOUR-Zen with a positive displacement pump into the main line ahead of a right angle turn to insure adequate mixing. Any questions on calibration should be directed to your State Extension Service Specialists, to equipment manufacturers or other experts.

Do not combine ARMOUR-Zen with pesticides, surfactants or fertilizers for application through chemigation equipment unless prior experience has shown the combination physically compatible, effective and non-injurious under conditions of use. ARMOUR-Zen has not been fully evaluated for compatibility with all adjuvants or surfactants. It is advisable to conduct a spray compatibility test if a mixture with adjuvants or surfactants is planned.

GENERAL PRECAUTIONS FOR APPLICATIONS THROUGH SPRINKLER IRRIGATION SYSTEMS

Maintain continuous agitation in the mix tank during mixing and application to insure a uniform suspension. Greater accuracy in calibration and distribution will be achieved by injecting a larger volume for a more dilute solution per unit time. Crop injury or lack of effectiveness can result from non-uniform distribution of treated water. 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. Allow sufficient time for pesticide to be flushed through all lines and all nozzles before turning off irrigation waters.

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 backflow.

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 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. Do not apply when wind speed favors drift beyond the area intended for treatment.

Do not apply when wind speed favors drift, when system connections or fittings leak, when nozzles do not provide uniform distribution or when lines containing the product must be dismantled and drained.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

Pesticide Storage: Store in a cool, dry place at or below 68°F (20°C). Store in original container only. Keep container tightly closed when not in use.

Pesticide Disposal: Wastes resulting from use of this product must be disposed of on site or at an approved waste disposal facility.

Container Handling: Nonrefillable container. Do not reuse or refill this container. Offer for recycling, if available. Triple rinse container promptly after emptying.

(Containers 5 gallons or less)

Triple rinse as follows: Fill container ¼ full with water and recap. Agitate vigorously. Follow Pesticide Disposal instructions for rinsate disposal. Drain for 10 seconds after the flow begins to drip. Repeat procedure two more times. Then offer for recycling or reconditioning. If not available, puncture and dispose in a sanitary landfill.

(Containers greater than 5 gallons):

Triple rinse as follows: Fill container ¼ full with water. 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. Follow Pesticide Disposal instructions for rinsate disposal. Repeat this procedure two more times. Then offer for recycling or reconditioning. If not available, puncture and dispose in a sanitary landfill.

WARRANTY STATEMENT

Botry-Zen (2010) Limited warrants that this product conformed to its description and was reasonably fit for the purposes stated on the label when used in accordance with Seller's directions. Buyers and users of this product assume the risk of any use contrary to such directions. SELLER MAKES NO OTHER EXPRESS OR IMPLIED WARRANTY OR GARANTEE, INCLUDING ANY OTHER EXPRESS OR IMPLIED WARRANTY OF FITNESS OR OF MERCHANTABILITY AND NO AGENT OF SELLER IS AUTHORIZED TO DO SO. To the extent consistent with applicable law, the Seller's liability for any breach of warranty shall not exceed the purchase price of the material as to which a claim is made.

To the extent consistent with applicable law, Buyers and users of this product are responsible for all loss or damage from use or handling of this product which results from conditions beyond the control of Seller, or without the fault or negligence of the Seller, or from failure to follow the label.

Sublabel B: Home and Garden Use

ARMOUR-Zen®

ACTIVE INGREDIENT:
Chitosan 30.00%
OTHER INGREDIENTS: 70.00%
TOTAL: 100.00%

Product contains 2.5 lb (1134 g) of chitosan per gallon.

KEEP OUT OF REACH OF CHILDREN
CAUTION

FIRST AID	
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 treatment advice.
HOTLINE NUMBER Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-800-222-1222 for emergency medical treatment information.	

See (back) (side) panel for additional precautionary statements and directions for use.

EPA Reg. No.: (Pending as File Symbol 75747-G)
EPA Establishment No.: XXXXX-XX-XX
(**Batch No. / Lot No.:** XXX)

Net Weight: XX lbs (XX kg)

Manufactured by:
Botry-Zen (2010) Limited
156 Frederick Street, P.O. Box 1777
Dunedin 9054
New Zealand
www.botryzen.co.nz

Distributed by:
(U.S. name and address –to be determined)

PRECAUTIONARY STATEMENTS

Hazards to humans and domestic animals - CAUTION. Causes moderate eye irritation. Avoid contact with eyes or clothing. Wear goggles or safety glasses, long sleeved shirt and long pants, gloves and shoes plus socks. 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.

Environmental Hazards: To protect the environment, do not allow pesticide to enter or run off into storm drains, drainage ditches, gutters or surface waters. Applying this product in calm weather when rain is not predicted for the next 24 hours will help to ensure that wind or rain does not blow or wash pesticide off the treatment area. Rinsing application equipment over the treated area will help avoid runoff to water bodies or drainage systems.

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling.

HOW IT WORKS

ARMOUR-Zen is chitosan-based product that is antifungal and antibacterial, preventing spore germination and causing existing mycelia to shrink and lose structural integrity. AMOUR-Zen is effective against plant pathogens including powdery and downy mildews, *Botrytis, Phytophthora* spp., leaf spot, early and late blight, anthracnose, stem wilt, damp-off, stem cankering and blast. ARMOUR-Zen can be used throughout your growing season.

HOW TO APPLY

RATE: Mix 2 – 4 teaspoons of ARMOUR-Zen per gallon of water.

MIXING: Dilute ARMOUR-Zen with water and apply in conventional spray equipment. Partially fill the spray tank with clean water. Add the specified amount of ARMOUR-Zen to the tank. Finish filling the tank to the desired volume to obtain the proper spray concentration. Shake the spray tank and use spray mixture immediately. Do not allow spray mixture to stand overnight or for prolonged periods.

APPLICATION: Apply ARMOUR-Zen using spray equipment to the point of saturation. Good coverage and wetting is required. The amount of spray solution to apply will vary depending on the type of crop. Apply in sufficient water to achieve thorough coverage. Repeat at 7 – 10 day intervals as needed. ARMOUR-Zen can be applied in commonly used pressurized hand-held sprayers, spray trigger bottles and hose-end sprayers.

WHERE TO APPLY

Apply to the following types home and garden plants to control mildews, blights, spots and other common plant diseases:

Garden plants (including):
Asparagus, beets, broccoli, Brussels sprouts, cabbage, carrots, cane fruit (raspberry, blackberry, etc.) cauliflower, celery, collards, cucumbers, edible-podded legume vegetables including: snap bean, wax bean, yard long bean, jack bean, edible-pod pea, snow pea, sugar

snap pea; dried shelled beans and peas including: field bean, kidney bean, lima bean (dry), navy bean, pinto bean, adzuki bean, black-eyed pea, cowpea, mung bean, southern pea, lentil (dry); eggplant, grapes, herbs, horseradish, kale, lettuce, melons, mustard greens, onions, parsnips, pepper, potatoes, radish, rutabaga, salsify, squash (winter and summer), sweet potato, strawberry, tomatoes, turnip greens, and turnips.

Ornamentals-including annuals and perennials

Fruit and Nut Trees

Turf

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.
Pesticide Storage: Store in a cool dry place inaccessible to children.
Pesticide Disposal and Container Handling: If empty: Nonrefillable container. Do not reuse or refill this container. Place in trash and offer for recycling if available. **If partially filled:** Call your local solid waste agency or (800) 858-7378 (National Pesticide Information Center) for disposal instructions. Never place unused product down any indoor or outdoor drain.

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Pesticide Programs
Biopesticides and Pollution Prevention Division (7511P)
1200 Pennsylvania Ave., N.W.
Washington, D.C. 20460

NOTICE OF PESTICIDE:
_X_ Registration
___ Reregistration
(under FIFRA, as amended)

EPA Reg. Number:	**Date of Issuance:**
75747-5	1/16/2020

Term of Issuance:
Unconditional

Name of Pesticide Product:
Amour-Zen 15%

Name and Address of Registrant (include ZIP Code):

Botry-Zen (2010) Limited
156 Frederick Street, P.O. Box 5664
Dunedin 9054
New Zealand

Note: Changes in labeling differing in substance from that accepted in connection with this registration must be submitted to and accepted by the Biopesticides and Pollution Prevention Division prior to use of the label in commerce. In any correspondence on this product, always refer to the above EPA Registration Number.

On the basis of information furnished by the registrant, the above named pesticide is hereby registered under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA or the Act).

Registration is in no way to be construed as an endorsement or recommendation of this product by the U.S. Environmental Protection Agency (EPA). In order to protect health and the environment, the Administrator, on his or her motion, may at any time suspend or cancel the registration of a pesticide in accordance with the Act. The acceptance of any name in connection with the registration of a product under the Act is not to be construed as giving the registrant a right to exclusive use of the name or to its use if it has been covered by others.

This product is unconditionally registered in accordance with FIFRA section 3(c)(5) provided that you:

1. Submit and/or cite all data required for registration or registration review of your product when the EPA requires all registrants of similar products to submit such data.

2. Make the following labeling change before you release this product for shipment:

    - Revise the EPA Registration Number to read, "EPA Reg. No. 75747-5."

Signature of Approving Official:

Andrew C. Bryceland

Andrew Bryceland, Team Leader
Biochemical Pesticides Branch
Biopesticides and Pollution Prevention Division (7511P)
Office of Pesticide Programs

Date:
1/16/2020

EPA Form 8570-6

3. Submit one (1) copy of the final printed labeling for the record before you release this product for shipment.

Should you wish to add/retain a reference to your company's website on your label, then please be aware that the website becomes labeling under FIFRA and is subject to review by the EPA. If the website is false or misleading, the product will be considered to be misbranded and sale or distribution of the product is unlawful under FIFRA section 12(a)(1)(E). 40 CFR § 156.10(a)(5) lists examples of statements the EPA may consider false or misleading. In addition, regardless of whether a website is referenced on your product's label, claims made on the website may not substantially differ from those claims approved through the registration process. Therefore, should the EPA find or if it is brought to our attention that a website contains false or misleading statements or claims substantially differing from the EPA-approved registration, the website will be referred to the EPA's Office of Enforcement and Compliance Assurance.

Your release for shipment of this product constitutes acceptance of these terms. If these terms are not complied with, this registration will be subject to cancellation in accordance with FIFRA section 6. A stamped copy of the labeling is enclosed for your records. Please also note that the record for this product currently contains the following acceptable Confidential Statement of Formula (CSF):

- Basic CSF dated 06/24/2019

Any CSFs other than those listed above are superseded.

If you have any questions, please contact Menyon Adams of my team by phone at (703) 347-8496 or via email at adams.menyon@epa.gov.

Sincerely,

Andrew Bryceland, Team Leader
Biochemical Pesticides Branch
Biopesticides and Pollution
Prevention Division (7511P)
Office of Pesticide Programs

Enclosure

ARMOUR-Zen 15%®

MASTER LABEL, containing:
Sublabel A: Greenhouse and Field Use
Sublabel B: Home & Garden Use

EPA Reg. No.: 75747-L

ACCEPTED
01/16/2020
Under the Federal Insecticide, Fungicide and Rodenticide Act as amended, for the pesticide registered under EPA Reg. No. 75747-5

Sublabel A: Greenhouse and Field Use

ARMOUR-Zen 15%®

ACTIVE INGREDIENT:	
Chitosan	15.00%
OTHER INGREDIENTS:	85.00%
TOTAL:	100.00%

Product contains 1.24 lb (560 g) of chitosan per gallon.

KEEP OUT OF REACH OF CHILDREN
CAUTION

FIRST AID	
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 treatment advice.
HOTLINE NUMBER Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-800-222-1222 for emergency medical treatment information.	

See (back) (side) panel for additional precautionary statements and directions for use.

EPA Reg. No.: 75747-L
EPA Establishment No.: XXXXX-XX-XX
(**Batch No. / Lot No.:** XXX)

Net Weight: XX lbs (XX kg)

Manufactured by:
Botry-Zen (2010) Limited
156 Frederick Street, P.O. Box 1777
Dunedin 9054
New Zealand
www.botryzen.co.nz

Distributed by:
(U.S. name and address –to be determined)

PRECAUTIONARY STATEMENTS

Hazards to Humans and Domestic Animals - CAUTION. Causes moderate eye irritation. Avoid contact with eyes. Wear safety glasses or goggles. 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.

Personal Protective Equipment (PPE): Applicators and other handlers must wear long-sleeved shirt and long pants, waterproof gloves, and shoes plus socks. Follow the manufacturer's instructions for cleaning / maintaining PPE. If no such instructions for washables exist, use detergent and hot water. Keep and wash PPE separately from other laundry.

User Safety Recommendations: Users should remove clothing/PPE immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing. Users should 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: Do not apply directly to water, or to areas where surface water is present, or to intertidal areas below the mean highwater mark. Do not contaminate water when disposing of equipment washwater or rinsate.

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 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 the label about personal protective equipment (PPE), and restricted entry interval (REI). 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 hour.

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, waterproof gloves, shoes plus socks.

Exception: If the product is soil-injected or soil-incorporated, the Worker Protection Standard, under certain circumstances, allows workers to enter the treated area if there will be no contact with anything that has been treated.

Product Information: ARMOUR-Zen 15% is chitosan-based product that is antifungal and antibacterial, preventing spore germination and causing existing mycelia to shrink and lose structural integrity. ARMOUR-Zen 15% is effective against plant pathogens, soil and foliar diseases including powdery and downy mildews, *Botrytis, Phytophthora* spp., leaf spot, early and late blight, anthracnose, stem wilt, damp-off, stem cankering and blast. ARMOUR-Zen 15% can be used throughout the growing season in greenhouse and field applications.

(**Integrated Pest Management:** Integrating ARMOUR-Zen 15% into an overall pest management strategy and following best management practices (or practices known to reduce disease development) makes it less likely that disease will be established. Specific IPM strategies developed for your crop and location may be available from the Extension Service or other local agricultural authorities.)

Mixing and Application Instructions:
MIXING: Dilute ARMOUR-Zen 15% with water and apply in conventional spray equipment or through sprinkler irrigation. Partially fill the spray tank with clean water and begin agitation. Add the specified amount of ARMOUR-Zen 15% to the tank. Finish filling the tank to the desired volume to obtain the proper spray concentration. Use spray mixture immediately. Do not allow spray mixture to stand overnight or for prolonged periods.

APPLICATION: Apply ARMOUR-Zen 15% using conventional spray equipment to the point of saturation. Good coverage and wetting is required. The amount of spray solution to apply will vary depending on the type of crop. Most row crops will require up to 100 gallons of spray per acre. Apply in sufficient water to achieve thorough coverage.

COMPATIBILITY: ARMOUR-Zen 15% may be tank mixed with some fungicides. Do not tank mix ARMOUR-Zen 15% with more than one product. Consult specific product labels for additional information or restrictions concerning tank mixing. Observe the most restrictive of the labeling limitations and precautions of all products used in mixtures. It is always advisable to conduct a spray compatibility test when you plan to mix this product with another product. To determine the physical compatibility of this product with other products, use a jar test. Using a quart jar, add the proportionate amounts of the products to approximately one quart of water with agitation. Add dry formulations first, then flowables, and then emulsifiable concentrates 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 procedure for adding products to the spray tank.

ARMOUR-Zen 15% has been evaluated for phytotoxicity on a variety of crops under various normal growing conditions. However, testing all crop varieties, in all mixtures and combinations is not feasible. Prior to treating entire crop, test a small portion of the crop for sensitivity.

Foliar Applications:
ARMOUR-Zen 15% can be applied as a foliar spray by ground and by air. Mix 2 - 8 quarts in 100 gallons of water and apply at a sufficient spray volume to ensure complete coverage. The optimum concentration for most uses is 4 quarts per 100 gallons of water.

Soil Treatment Use Directions:
ARMOUR-Zen 15% can be applied by soil drench, in-furrow spray, or soil injection to improve plant health and to protect against certain soil-borne diseases.

In general, ARMOUR-Zen 15% can be applied by the following methods, unless specified differently in the SELECTED CROPS section:

Soil Drench Applications

Apply ARMOUR-Zen 15% at a concentration of 2 - 8 quarts per 100 gallons of water, and at a sufficient rate to thoroughly soak the growing media and root zone. Make an initial application during or shortly after transplant to control soil-borne diseases, reduce transplant shock, induce disease resistance, and to promote root growth. Multiple drench applications can be made on a 10 – 14 day schedule.

Shanked-In and Injected Applications

ARMOUR-Zen 15% can be shanked or injected into the soil alone, or with most types of liquid nutrients.

In-Furrow Applications

ARMOUR-Zen 15% can be applied at planting as an in-furrow spray. Mix 2 - 8 quarts of ARMOUR-Zen 15%® in 100 gallons of water and apply at 5 – 15 gallons per acre, directing the spray into the seed furrow just before the seeds are covered.

Application Rates for Selected Crops:
ARMOUR-Zen 15% used as specified will prevent, control and suppress a broad range of plant diseases, as well as induce the natural defense system of the treated plants listed below.

The general recommendation is to apply 2 - 8 quarts per 100 gallons of water. The optimum concentration for most applications is 4 quarts --per 100 gallons of water.

Application Rates for Foliar Spray:

Crops	Target Disease	Application Method	Use Rate per 100 Gallons	Notes
Artichoke	Powdery Mildew (*Erysiphe cichoracearum*) (*Leveillula taurica*) Ramularia Leaf Spot (*Ramularia cynarae)*	Foliar (Ground)	2 - 8 quarts	For ground applications, apply in 50 – 100 gallons of water per acre. Apply this product preventatively or at the first sign of disease symptoms are visible. Reapply every 7 – 14 days.
		Foliar (Aerial)	2 - 8 quarts	For aerial applications, apply this product in a minimum of 5 gallons of water per acre. Apply preventatively or when the first disease symptoms are visible and apply every 7 – 14 days.
		Chemigation	2 - 8 quarts	Apply through irrigation immediately after transplant and at 14- day intervals or begin 14 days after transplant when soil drench applications are used.
Asparagus	Botrytis Blight (*Botrytis cinerea*) Rust (*Puccinia aspargi*)	Foliar (Ground)	2 - 8 quarts	For ground applications, apply this product in 50 – 100 gallons of water per acre. Apply preventatively or when the first disease symptoms are visible and apply every 7 – 14 days.
		Foliar (Aerial)	2 - 8 quarts	For aerial applications, apply this product in a minimum of 5 gallons of water per acre. Apply preventatively or when the first disease symptoms are visible and apply every 7 – 14 days.
Berries, including: Blackberry Blueberry Bushberry Caneberry Cranberry Currants Elderberry Gooseberry Huckleberry Loganberry Raspberry	Botrytis Blight (*Botrytis cinerea*) Mummy Berry (*Monilinia vaccinii-corymbosi*) Alternaria Fruit Rot (*Alternaria* spp.) Anthracnose Fruit Rot (*Colletotrichum acutatum*) Bacterial Canker (*Pseudomonas syringae*) Leaf Rust (*Pucciniastrum vaccinii*)	Foliar (Ground)	2 - 8 quarts	Apply in 50 – 100 gallons per acre. Mummy Berry – Begin applications at bud break stage of development. Apply preventatively and repeat on a 7 -10 cay interval or as needed. Botrytis Blight – Apply this product preventatively prior to or at first sign of disease symptoms. Reapply every 7 – 14 days or as needed. Bacterial Canker – Apply prior to Fall rains and repeat applications during dormancy before Spring growth. This product can be tank mixed with another registered fungicide for improved control of bacterial canker. Anthracnose Fruit Rot and Alternaria Fruit Rot on blueberries – Apply at

	Leaf Spot and Blotch (*Mycosphaerella* spp.) (*Septoria* spp.) Phomopsis Leaf Spot, Twig Blight and Fruit Rot (*Phomopsis* spp.) Powdery Mildew (*Microsphaera alni*) Spur Blight (*Didymella* spp.) (*Phoma* spp.)			green tip and continue on a 7 – 10 interval.
		Foliar (Aerial)	2 - 8 quarts	For aerial applications, apply this product in a minimum of 5 gallons of water per acre.
Bulb Vegetables, including: Garlic Leeks Onions (Bulb and Green) Shallots And other bulb vegetable crops	Botrytis Leaf Blight (*Botrytis squamosa*) Botrytis Neck Rot (*Botrytis* spp.) Onion Purple Blotch (*Alternaria* porri) Downy Mildew (*Peronospora* spp.) Powdery Mildew (*Erysiphe* spp.) Rust (*Puccinia porri*) Stemphyllium Leaf Blight (*Stemphylium vesicarium*)	Foliar	2 - 8 quarts	Apply preventively in 50 – 100 gallons of water per acre. Repeat applications at 7 – 14 day intervals.
	Fusarium spp. *Pythium* spp. *Rhizoctonia* spp.	Soil Drench	2 - 8 quarts	Apply at a concentration of 2 - 8 quarts per 100 gallons of water, thoroughly soaking the growing media and root zone. Apply during or shortly after transplant to reduce transplant shock, suppress soilborne disease and improve root growth. Multiple drench applications can be made on a 10 – 14 day interval.
		In-Furrow	2 - 8 quarts	Apply as an in-furrow spray at planting at the rate of 2 - 8 quarts per 100 gallons of water. Apply in 5 – 15 gallons of water and direct the spray into the seed furrow just before the seeds are covered.
		Plant Dip	2 - 8 quarts	Apply as a 0.5 – 2% suspension (2 - 8 quarts per 100 gallons) as a pre-plant dip immediately prior to transplant.
		Chemigation	2 - 8 quarts	Apply through irrigation immediately after transplant and at 14- day intervals or begin 14 days after transplant when soil drench applications are used.

Cereal Grains, including: Barley Buckwheat Grain Amaranth Milo Oat Millets Rice Rye Sorghum Triticale Wheat	Powdery Mildew (*Erysiphe graminis*) Bacterial Blight and Streak (*Xanthomonas* spp.) Brown Rot, Leaf Spots & Smuts (*Ceratobasidium* spp.) (*Cercospora* spp.) (*Drechslera* spp.) Rice Blast (*Pyricularia grisea*) Rust (*Puccinia* spp.) Septoria Leaf Spot (*Septoria* spp.) Sheath Spot and Blight (*Rhizoctonia oryzae*) (*Thanatephorus cucumeris*) Stem Rot (*Sclerotium oryzae*) Smut (*Tilletia barclayana*)	Foliar (Ground)	2 - 8 quarts	To optimize disease control and to maximize yields, apply in 15 – 40 gallons of water per acre. Apply preventatively or when disease symptoms first appear. Repeat applications on a 7 – 14 day interval depending upon crop growth and disease pressure. When plants are under high disease pressure, tank mix this product with another registered fungicide for more effective control.
		Foliar (Aerial)	2 - 8 quarts	For aerial applications, apply this product in a minimum of 5 gallons of water per acre. Apply preventatively or at the first sign of disease symptoms. Repeat applications at 7 – 14 day intervals.
Citrus Fruits, including: Calamondin Citrus citron Citrus hybrids Grapefruit Kumquat Lemon Lime Mandarin Orange, sour and sweet Pummelo Satsuma mandarin	Bacterial Canker (*Xanthomonas* spp.) Alternaria Brown Spot (*Alternaria alternata*) Bacterial Blast (*Pseudomonas syringae*) Black Spot (*Guignardia citricarpa*) (*Phyllosticta citricarpa*) Greasy Spot (*Mycosphaerella citri*) Melanose (*Diaporthe citri*) Postbloom Fruit Drop (*Colletotrichum acutatum*) Scab (*Elsinoe australis*) (*Elsinoe fawcetti*)	Foliar (Ground)	2 - 8 quarts	Apply in 50 – 100 gallons per acre. Begin application when conditions are conducive to disease development. Repeat on 7 to 10 day intervals or as needed.
		Foliar (Arial)	2 - 8 quarts	For aerial applications, apply this product in a minimum of 5 gallons of water per acre. Apply preventatively or at the first sign of disease symptoms. Repeat applications at 7 – 14 day intervals.

Cole Crops (Brassicas), including: Broccoli Broccoli Rabe Brussels Sprouts Cabbage Chinese Broccoli Chinese Cabbage (Bok Choy) Chinese Cabbage (Napa) Chinese Mustard Cabbage (Gai Choy) Cauliflower Cavalo Collards Kale Kohlrabi Mizuna Mustard Greens Mustard Spinach Rape Greens Turnip	Powdery Mildew (*Erysiphe cruciferarum*) (*Erysiphe polygoni*) Alternaria Leaf Spot (*Alternaria* spp.) Downy Mildew (*Peronospora parasitica*) Pin Rot Complex (*Alternaria, Xanthomonas*) Xanthomonas Leaf Spot (*Xanthomonas campestris*)	Foliar (Ground)	2 - 8 quarts	Apply in 50 – 100 gallons per acre. Begin application when conditions are conducive to disease development. Repeat on 7 to 10 day intervals or as needed.
		Foliar (Arial)	2 - 8 quarts	For aerial applications, apply this product in a minimum of 5 gallons of water per acre. Apply preventatively or at the first sign of disease symptoms. Repeat applications at 7 – 14 day intervals.
Corn, including: Sweet Corn Field Corn Popcorn Silage Corn Seed Corn	Anthracnose Leaf Blight (*Colletotrichum graminicola*) Eye Spot (*Aureobasidium zeae*) Gray Leafspot (*Cercospora zeae-maydis*) Rusts (*Puccinia* spp.) Northern Leaf Blight (*Cochiliobus carbonum*) Southern Leaf Blight (*Cochiliobus heterostrophus*)	Foliar (Ground)	2 - 8 quarts	Apply in 15 – 40 gallons per acre. Begin application when conditions are conducive to disease development. Repeat on 7 to 10 day intervals or as needed.
		Foliar (Arial)	2 - 8 quarts	For aerial applications, apply this product in a minimum of 3 gallons of water per acre. Apply preventatively or at the first sign of disease symptoms. Repeat applications at 7 – 14 day intervals.
Cotton	Alternaria Leaf Spot, Boll Rot (*Alternaria* spp.) Anthracnose, Boll Rot (*Anthracnose* spp.) Ascochyta Blight, Boll Rot (*Ascochyta* spp.) Cercospora Blight and Leaf Spot (*Cercospora* spp.)	Foliar (Ground)	2 - 8 quarts	Apply in 15 – 40 gallons per acre. Begin application when conditions are conducive to disease development. Repeat on 7 to 10 day intervals or as needed.
		Foliar (Arial)	2 - 8 quarts	For aerial applications, apply this product in a minimum of 3 gallons of water per acre. Apply preventatively or at the first sign of disease symptoms. Repeat applications at 7 – 14 day intervals.

	Diplodia Boll Rot (*Diplodia* spp.) Hard Lock, Boll Rot (*Fusarium* spp.) Leaf Spot (Corynespora cassicola) Phoma Blight, Boll Rot (*Phoma* spp.) Rust (*Puccinia* spp.) (*Phykopsora* spp.) Stemphyllium Leaf Spot (*Stemphyllium* spp.)			
Cucurbits **Includes all types and hybrids of:** Chayote Chinese Waxgourd Cucumber Citron Melon Gherkin Pumpkin Watermelon **Edible Gourd:** Chinese Okra Cucuzza Hyotan ***Mormordica* spp.** Balsam Apple Balsam Pear Bitter Melon Chinese Cucumber **Muskmelon:** Cantaloupe Casaba Crenshaw Melon Golden Pershaw Melon Honeydew Melon Honey Balls Mango Melon Persian Melon Pineapple Melon Santa Clause Melon Snake Melon **Summer Squash:** Crookneck Squash Scallop Squash Straightneck Squash	Powdery Mildew (*Erysiphe cichoracearum*) (*Sphaerotheca fuliginea*) Anthracnose (*Colletotrichum lagenarium*) Alternaria Leaf Spot (*Cercospora citrulina*) Downy Mildew (*Pseudoperonospora cubensis*) Gummy Stem Blight (*Didymella bryoniae*) Phytophthora Blight (*Phytophthora capsici*)	Foliar (Ground)	2 - 8 quarts	Apply preventatively in 25 – 100 gallons of water per acre or at first sign of disease symptoms. Increase water volume as plant size increases. Reapply on a 7 -14 day interval depending on plant growth and disease pressure. Use shorter spray intervals for greenhouse cucurbits when under high disease pressure.
		Foliar (Aerial)	2 - 8 quarts	For aerial applications, apply this product in a minimum of 5 gallons of water per acre. Apply preventatively or at the first sign of disease symptoms. Repeat applications at 7 – 14 day intervals.
	Fusarium spp. *Phytophthora* spp. *Pythium* spp. *Rhizoctonia* spp.	Soil Drench	2 - 8 quarts	Apply at a concentration of 2 - 8 quarts per 100 gallons of water, thoroughly soaking the growing media and root zone. Apply during or shortly after transplant to reduce transplant shock, suppress soilborne disease and improve root growth. Multiple drench applications can be made on a 10 – 14 day interval.
		In-Furrow	2 - 8 quarts	Apply as an in-furrow spray at planting at the rate of 2 - 8 quarts per 100 gallons of water. Apply in 5 – 15 gallons of water and direct the spray into the seed furrow just before the seeds are covered.
		Plant Dip	2 - 8 quarts	Apply as a 0.5 – 2% suspension (2 - 8 quarts per 100 gallons) as a pre-plant dip immediately prior to transplant.

Vegetable Marrow Zucchini **Winter Squash:** Acorn Squash Butternut Squash Calabaza Gubbard Squash Spaghetti Squash And other cucurbit crops		Chemigation	2 - 8 quarts	Apply through irrigation immediately after transplant and at 14 day intervals or begin 14 days after transplant when soil drench applications are used.
Fruiting Vegetables, including: Eggplant Okra Pepper Tomato Tomatillo Ground Cherry	Bacterial Blight (*Xanthomonas* spp.) Bacterial Spot (*Xanthomonas* spp.) Bacterial Speck (*Pseudomonas syringae*) Black Mold (*Alternaria alternata*) Early Blight (*Alternaria solani*) Gray Mold (*Botrytis cinerea*) Late Blight (*Phytophthora capsici*) Powdery Mildew (*Erysiphe* spp.) (*Leveillula taurica*) (*Oidopsis taurica*) (*Sphaerotheca* spp.) Target Spot (*Corynespora cassiicola*)	Foliar (Ground)	2 - 8 quarts	Apply preventatively in 25 – 100 gallons of water per acre or at first sign of disease symptoms. Increase water volume as plant size increases. Reapply on a 7 - 10 day interval depending on plant growth and disease pressure. Use shorter spray intervals for greenhouse cucurbits when under high disease pressure.
		Foliar (Arial)	2 - 8 quarts	For aerial applications, apply this product in a minimum of 3 gallons of water per acre. Apply preventatively or at the first sign of disease symptoms. Repeat applications at 7 – 10 day intervals.
	Fusarium spp. *Phytopthora* spp. *Rhizoctonia* spp. *Verticllium* spp.	Soil Drench	. 2 - 8 quarts	Apply at a concentration of 2 - 8 quarts per 100 gallons of water, thoroughly soaking the growing media and root zone. Apply during or shortly after transplant to reduce transplant shock, suppress soilborne disease and improve root growth. Multiple drench applications can be made on a 10 – 14 day interval.
		In-Furrow	2 - 8 quarts	Apply as an in-furrow spray at planting at the rate of 2 - 8 quarts per 100 gallons of water. Apply in 5 – 15 gallons of water and direct the spray into the seed furrow just before the seeds are covered.

		Plant Dip	2 - 8 quarts	Apply as a 0.5 – 2% suspension (2 - 8 quarts per 100 gallons) as a pre-plant dip immediately prior to transplant.
		Chemigation	2 - 8 quarts	Apply through irrigation immediately after transplant and at 14- day intervals or begin 14 days after transplant if soil drench applications are used.
Grapes	Powdery Mildew (*Uncinula necator*) Angular Leaf Spot (*Mycosphaerella angulata*) Anthracnose (*Elsinoe ampelina*) Botrytis Bunch Rot (*Botrytis cinerea)* Black Rot (*Guignardia bidwellii*) Downy Mildew (*Plasmopara viticola*) Eutypa (*Eutypa lata*) Leaf Blight (*Pseudocercospora vitis*) Phomopsis Fruit Rot (*Phomopsis viticola*) Ripe Rot (*Colletotrichum gloeosporioides*) Sour Rot (*Alternaria tenuis*) (*Aspergillus* spp.) (*Botrytis cinerea*) (*Cladosporium herbarum*) (*Penicillium* spp.) (*Rhizopus arrhizus*)	Foliar	2 - 8 quarts	Apply preventively in 50 – 100 gallons of water per acre or the first signs of disease symptoms. Repeat applications at 7 – 14 day intervals depending on crop growth and disease pressure. .
Grass Seed	Powdery Mildew (*Erysiphe gramminis*) (*Oidium* spp.) (*Podosphaera* spp.) (*Sphaerotheca* spp.) Rust (*Puccinia* spp.)	Foliar (Ground)	2 - 8 quarts	Apply preventatively in 25 – 100 gallons of water per acre when disease symptoms are first visible or when environmental conditions are conducive to rapid disease development. Reapply on a 7-day interval or as needed.
				Apply preventatively in 50 – 100

Hops	Downy Mildew (*Pseudoperonosperora humili*) Powdery Mildew (*Sphaerotheca macularis*)	Foliar (Ground)	2 - 8 quarts	gallons of water or when environmental conditions are conducive to rapid disease development. Reapply on a 7-day interval or as needed.
Leafy Vegetables, including: Arugula Beet Celery Chervil Cilantro Corn Salad Cress Dandelion Dock Edible Chrysanthemum Endive Fennel Garden Peas Head Lettuce Leaf Lettuce Parsley Purslane Radicchio Rhubarb Spinach Swiss Chard Watercress	Downy Mildew (*Bremia lactuca*) (*Peronospora* spp.) Bacterial Blight/Rot (*Xanthomonas* spp.) Cercospora Leafspot (*Cercospora* spp.) Late Blight (*Septoria apiicola*) Pink Rot (*Sclerotinia sclerotiorum*) Powdery Mildew (*Erysiphe cichoracearum*) Sclerotinia Had and Leaf Drop (*Sclerotinia minor*) (*Sclerotinia sclerotiorum*) White Rust (*Albugo occidentalis*)	Foliar (Ground)	2 - 8 quarts	Apply preventatively in 50 – 100 gallons of water or when environmental conditions are conducive to rapid disease development. Reapply on a 7-14 day interval or as needed. For concentrated ground applications, apply this product at 2 - 4 quarts per acre in a minimum of 10 gallons of water per acre.
		In-Furrow	2 - 8 quarts	Apply as an in-furrow spray at planting at the rate of 2 - 4 quarts per acre or 4.4 – 8.8 fluid ounces per 1000 feet of row. Apply in 5 – 15 gallons of water and direct the spray into the seed furrow just before the seeds are covered.

Legumes, succulent and dried, (not including soybeans and peanuts)**:** Chick Peas Dry Beans Garbanzo Beans Green Beans Lentils Lima Beans Peas Shell Beans Snap Beans Split Peas And other legume crops	Bacterial Blight (*Xanthomonas campestris*) Gray Mold (*Botrytis cinerea*) Pythium (aerial blight phase) (*Pythium* spp.) Powdery Mildew (*Erysiphe* spp.) Rust (*Puccinia* spp.) (*Uromyces appendiculatus*) White Mold (*Sclerotinia sclerotiorum*)	Foliar (Ground)	2 - 8 quarts	Apply preventatively in 50 – 100 gallons of water or when environmental conditions are conducive to rapid disease development. Reapply on a 7-day interval or as needed.
	Fusarium spp. *Phytophthora* spp. *Pythium* spp. *Rhizoctonia* spp.	In-Furrow	2 - 8 quarts	Apply as an in-furrow spray at planting at the rate of 2 - 4 quarts per acre or 4.4 – 8.8 fluid ounces per 1000 feet of row. Apply in 5 – 15 gallons of water and direct the spray into the seed furrow just before the seeds are covered.
Mint and other Herbs/Spices, including: Angelica Balm Basil Borage Burnet Chamomile Catnip Chervil Chive Clary Coriander Costmary Cilantro Curry Dillweed Horehound Hyssop Lavender Lemongrass Lovage	Downy Mildew (*Peronospora* spp.) Powdery Mildew (*Erysiphe* spp.) Rust (*Puccinia menthae*)	Foliar (Ground)	2 - 8 quarts	Apply preventatively in 50 – 100 gallons of water per acre or at first sign of disease symptoms. Reapply on a 7 - 10 day interval depending on plant growth and disease pressure.
		Foliar (Arial)	2 - 8 quarts	For aerial applications, apply this product in a minimum of 5 gallons of water per acre. Apply preventatively or at the first sign of disease symptoms. Repeat applications at 7 – 10 day intervals.

Marjoram Nasturtium Parsley (dried) Peppermint Rosemary Sage Savory (summer and winter) Sweet Bay Tansy Tarragon Thyme Wintergreen Woodruff Wormwood				
Oil Seed Crops, including: Canola Castor Flax Rapeseed Safflower Sesame Sunflower (does not include cotton, peanut or soybean)	Bacterial Pustule (*Xanthomonas* spp.) Bacterial Speck (*Pseudomonas syringe pv. glycinea*) Brown Spot (*Septoria glycines*) Cercospora Leaf Spot (*Cercospora* spp.) Downy Mildew (*Peronospora mansherica*) Pod and Stem Blight (*Diaporthe phaseolorum* var. *sojae*) (*Phomopsis longicola*) White Mold/Sclerotinia Stem Rot (*Sclerotinia sclerotiorum*)	Foliar (Ground)	2 - 8 quarts	To optimize disease control and maximize yields, apply this product preventatively in 15 – 40 gallons of water per acre. Consult your local Extension Specialist or Crop Consultant regarding the optimum timing of fungicide applications.
		Foliar (Arial)	2 - 8 quarts	For aerial applications, apply this product in a minimum of 3 gallons of water per acre. Consult your local Extension Specialist or Crop Consultant regarding the optimum timing of fungicide applications.
Olive	Olive Knot (*Pseudomonas savastanoi*)	Foliar	2 - 8 quarts	Apply preventatively in 50 – 100 gallons of water per acre. Repeat application at 7 – 14 day intervals or as needed.
Ornamental Plants **Herbaceous Ornamentals** Flowering Plants Foliage Plants **Woody Ornamentals** Broadleaves, Shrubs and trees Conifers,	Anthracnose (*Colletotrichum* spp.) Bacteria (*Erwinia* spp.) (*Pseudomonas* spp.) (*Xanthomonas* spp.) Black Spot of Rose (*Diplocarpon rosae*) Blossom Blight (*Monilinia* spp.)	Foliar	2 - 8 quarts	Apply preventatively in 50 – 100 gallons of water and repeat on 7 – 14 day intervals, or as needed. This product may be used to control certain diseases of container, bench, flat, plug, bed, or field-grown ornamentals in greenhouses, shade houses, outdoor nurseries, retail nurseries, and other landscape areas.

Shrubs and trees	Downy Mildew (*Peronospora* spp.) (*Plasmopara viburni*) Gray Mold (*Botrytis cinerea)* Leaf Spot (*Alternaria* spp.) (*Cercospora* spp.) (*Entomosporium* spp.) (*Myrothecium* spp.) (*Septoria* spp.) Powdery Mildew (*Erysiphe* spp.) (*Oidium* spp.) (*Podosphaera* spp.) (*Sphaerotheca* spp.) Rust (*Puccinia* spp.) Scab (*Venturia* spp.)			
	Fusarium spp. *Phytophthora* spp. *Pythium* spp. *Rhizoctonia* spp. *Verticillium* spp.	Soil Drench	2 - 8 quarts	Apply at a concentration of 2 - 8 quarts per 100 gallons of water, thoroughly soaking the growing media and root zone. Apply during or shortly after transplant to reduce transplant shock, suppress soilborne disease and improve root growth. Multiple drench applications can be made on a 10 – 14 day interval.
		Plant Dip	2 - 8 quarts	Apply as a 0.5 – 2% suspension (2 - 8 quarts per 100 gallons) as a pre-plant dip immediately prior to transplant.
		Chemigation	2 - 8 quarts	Apply through irrigation immediately after transplant and at 14- day intervals or begin 14 days after transplant if soil drench applications are used.
Since it is not possible to test all ornamental species or varieties grown, test ARMOUR-Zen 15% on a few plants prior to large-scale usage.				
Peanut	Aspergillus Crown Rot (*Aspergillus niger*) Rhizoctonia Foliar Blight, Peg, and Root Rot (*Rhizoctonia solani*) White Mold (*Sclerotium rolfsii*)	Foliar	2 - 8 quarts	Apply preventatively in 50 – 100 gallons of water and repeat on 7 – 14 day intervals, or as needed.
	Aspergillus Crown Rot (*Aspergillus niger*) *Fusarium* spp. *Phytophthora* spp.	Soil Drench	2 - 8 quarts	Apply at a concentration of 2 - 8 quarts per 100 gallons of water, thoroughly soaking the growing media and root zone. Apply during or shortly after transplant to reduce transplant shock, suppress soilborne disease and

	Pythium spp. *Rhizoctonia* spp. *Verticillium* spp. White Mold (*Sclerotium rolfsii*)			improve root growth. Multiple drench applications can be made on a 10 – 14 day interval.
		In-Furrow	2 - 8 quarts	Apply as an in-furrow spray at planting at the rate of 2 – 4 quarts per acre or 4.4 – 8.8 fluid ounces per 1000 feet of row. Apply in 5 – 15 gallons of water and direct the spray into the seed furrow just before the seeds are covered.
Pome Fruits, including: Apple Crabapple Loquat Mayhaw Pear Pear, oriental Quince	Powdery Mildew (*Podosphaera leucotricha*) Alternaria Blotch (*Alternaria mali*) Apple Scab (*Venturia inaequalis*) Bitter Rot (*Colletotrichum* spp.) Black Rot/ Frogeye Leaf Spot (*Botryosphaeria obtusa*) Bot Rot (*Botryosphaeria dothidea*) Brooks Spot (*Mycosphaerella pomi*) Bull's Eye Rot (*Neofabraea* spp.) Cedar-Apple Rust (*Gymnosporangium juniper-virginianae*) Fire Blight (*Erwinia amylovora*) Flyspeck (*Zygophiala jamaicensis*) Sooty Blotch (*Geastrumia polystigmati*) Leptodontium elatius) (*Peltaster fructicola*) White Rot (*Botryosphaeria dothidea*)	Foliar	2 - 8 quarts	Apply in 50 – 100 gallons of water per acre. Begin applications when conditions are conducive to disease development. Repeat applications on 3 – 10 day intervals or as needed. Use high label rate and shorter spray intervals when conditions are conducive to rapid disease development.

Root, Tuber and Corm Vegetables, including: Beets Carrots Cassava Ginger Ginseng Horseradish Potato Radish Sugar beets Sweet potato Yams Turnip	Bacterial Leaf Blight (*Xanthomonas campestris*) Black Root Rot / Black Crown Rot (*Alternaria* spp.) Downy Mildew (*Peronospora* spp.) Early Blight (*Alternaria* spp.) Gray Mold (*Botrytis cinerea)* Late Blight (*Phytophthora infestans*) Powdery Mildew (*Erysiphe* spp.) White Mold (*Sclerotinia sclerotiorum*) Clubroot (*Plasmodiophora brassicae*) Common Scab (*Streptomyces scabies*) *Fusarium* spp. *Phytopthora* spp. *Pythium* spp. *Rhizoctonia* spp. *Verticillium* spp.	Foliar	2 - 8 quarts	Apply preventatively in 25 – 100 gallons of water and repeat on 5 – 10 day intervals, or as needed. Begin applications soon after emergence or transplant and when conditions are conducive to disease development. Use higher rates and shorter intervals when conditions favor rapid disease development.
		Soil Drench	2 - 8 quarts	Apply at a concentration of 2 - 8 quarts per 100 gallons of water, thoroughly soaking the growing media and root zone. Apply during or shortly after transplant to reduce transplant shock, suppress soilborne disease and improve root growth. Multiple drench applications can be made on a 10 – 14 day interval.
		In-Furrow	2 - 8 quarts	Apply as an in-furrow spray at planting at the rate of 2 – 4 quarts per acre or 4.4 – 8.8 fluid ounces per 1000 feet of row. Apply in 5 – 15 gallons of water and direct the spray into the seed furrow just before the seeds are covered.
		Chemigation	2 - 8 quarts	Apply through irrigation immediately after transplant and at 14- day intervals or begin 14 days after transplant if soil drench applications are used.
Soybean	Aerial Web Blight (*Rhizoctonia solani*) Alternaria Leafspot (*Alternaria* spp.) Anthracnose (Colletotrichum truncatum)	Foliar (Ground)	2 - 8 quarts	To optimize disease control and maximize yields, apply this product preventatively in 15 – 40 gallons of water per acre. Consult your local Extension Specialist or Crop Consultant regarding the optimum timing of fungicide applications.

	Asian Soybean Rust (*Phakopsora pachyrhizi*) Brown Spot (*Septoria glycines*) Cercospora Blight (*Cercospora kikuchii*) Frog-eyed Leaf spot (*Cercospora sojina*) Pod and Stem Blight (*Diaporthe* spp.) Septoria Brown Spot (*Septoria glycines*) White Mold (*Sclerotinia sclerotiorum*) .	Foliar (Arial)	2 - 8 quarts	For aerial applications, apply this product in a minimum of 3 gallons of water per acre. Consult your local Extension Specialist or Crop Consultant regarding the optimum timing of fungicide applications.
	Fusarium spp. *Phytopthora* spp. *Pythium* spp. *Rhizoctonia* spp	In-Furrow	2 - 8 quarts	Apply as an in-furrow spray at planting at the rate of 2 - 4 quarts per acre or 4.4 – 8.8 fluid ounces per 1000 feet of row. Apply in 5 – 15 gallons of water and direct the spray into the seed furrow just before the seeds are covered.
Stone Fruits, including: Apricot Cherry, sweet and tart Nectarine Peach Plum Plumcot Prune (fresh)	Alternaria Spot/Fruit Rot (*Alternaria alternata*) Anthracnose (*Colletotrichum* spp.) Bacterial Canker (*Pseudomonas* spp.) Bacterial Spot (*Pseudomonas* spp.) Brown Rot Blossom Blight and Fruit Rot (*Monilinia* spp.) Cercospora Leaf Spot (*Cercospora* spp.) Cherry Leaf Rot (*Blumeriella jaapii*) Gray Mold (*Botrytis cinerea*) Jacket Rot, Green Fruit Rot *(Botrytis cinerea,*	Foliar	2 - 8 quarts	Apply preventively in 50 – 100 gallons of water when conditions are conducive to disease development. Apply on a 7 – 10 day spray interval or as needed. Bacterial Blight – Apply postharvest before Fall rains. Brown Rot Blossom Blight – Apply at early bloom and repeat on a 7-day schedule through petal fall or as needed. Powdery Mildew – Begin applications at popcorn stage and repeat on a 7-interval or as needed. Scab- Begin applications at petal fall and repeat on a 7 – 10 day interval or as needed.

	Monilinia spp., *Sclerotinia sclerotiorum)* Powdery Mildew (*Podosphaera* spp.) (*Sphaerotheca pannosa*) Rust (*Tranzschelia discolor*) Rusty Spot (*Podosphaera leucotricha*) Scab (*Cladosporium carpophilium*) Shot Hole (*Wilsonomyces carpophilus*)			
Strawberry	Anthracnose (*Colletotrichum* spp.) Botrytis (*Botrytis cinerea*) Leaf Spot (*Mycosphaerella fragariae*) Phomopsis Leaf Blight (*Phomopsis obscurans*) Powdery Mildew (*Sphaerotheca macularis*)	Foliar	2 - 8 quarts	Apply preventively in 50 – 100 gallons of water when conditions are conducive to disease development. Apply on a 7 – 10 day spray interval or as needed.
	Black Root Rot (*Rhizoctonia* spp.) (*Pythium* spp.) (*Fusarium* spp.) (*Cylindrocarpon* spp.) Phytophthora Root Rot and Crown Rot (*Phytophthora* spp.) Verticillium Wilt (*Verticillium* spp.) *Fusarium* spp. *Pythium* spp. *Rhizoctonia* spp.	Soil Drench	2 - 8 quarts	Apply at a concentration of 2 - 8 quarts per 100 gallons of water, thoroughly soaking the growing media and root zone. Apply during or shortly after transplant to reduce transplant shock, suppress soilborne disease and improve root growth. Multiple drench applications can be made on a 10 – 14 day interval.
		Plant Dip	2 - 8 quarts	Apply as a 0.5 – 2% suspension (2 - 8 quarts per 100 gallons) as a pre-plant dip immediately prior to transplant.
		Chemigation	2 - 8 quarts	Apply through irrigation immediately after transplant and at 14 - day intervals or begin 14 days after transplant if soil drench applications are used.

Sugar Beets	Powdery Mildew (*Erysiphe betae*) (*Erysiphe polygoni*) Leaf Spot (*Cercospora beticola*) Ramularia (*Ramularia* spp.) Rust (*Uromyces betae*)	Foliar	2 - 8 quarts	Apply preventatively in 15 – 40 gallons of water per acre by ground or air. Consult your local Extension Specialist or Crop Consultant for optimum timing of fungicide applications.
Sugarcane	Brown Rust (*Puccinia melanocephela*) Orange Rust (*Puccinia kuehnii*)	Foliar (Ground)	2 - 8 quarts	Apply preventatively in 15 – 40 gallons of water per acre by ground or air. Consult your local Extension Specialist or Crop Consultant for optimum timing of fungicide applications
		Foliar (Aerial)	2 - 8 quarts	Apply preventatively in a minimum of 3 gallons of water per acre by ground or air. Consult your local Extension Specialist or Crop Consultant for optimum timing of fungicide applications.
Tobacco	Blue Mold (*Peronospora tabacina*)	Foliar	2 - 8 quarts	Apply preventatively in a minimum of 50 gallons of water per acre. Consult your local Extension Specialist or Crop Consultant for optimum timing of fungicide applications.
	Fusarium spp. *Phytophthora* spp. *Pythium* spp. *Rhizoctonia* spp. *Verticillium* spp.	Plant Dip	2 - 8 quarts	Apply as a 0.5 – 2% suspension (2 - 8 quarts per 100 gallons) as a pre-plant dip immediately prior to transplant.
Tree nuts, including: Almond Beech nut Brazil nut Butternut Cashew Chestnut Chinquapin Filbert (hazelnut) Hickory nut Macadamia nut Pecan Walnut, Black and English	Walnut Blight (*Xanthomonas campestris*) Alternaria Late Blight, Alternaria Leaf Spot (*Alternaria spp.*) Anthracnose (*Colletotrichum* spp.) (*Gnomonia leptostyla*) Bacterial Canker (*Erwinia nigrifluens*) Botryosphaeria Blight (*Botryosphaeria dothidea*)	Foliar (Ground)	2 - 8 quarts	Apply preventively in 50 – 100 gallons of water when conditions are conducive to disease development. Apply on a 7 – 10 day spray interval or as needed.
		Foliar (Arial)	2 - 8 quarts	For aerial applications, apply this product in a minimum of 10 gallons of water per acre.

	Brown Rot (*Monilinia* spp.) Jacket Rot, Green Fruit Rot *(Botrytis cinerea, Monilinia* spp*., Sclerotinia sclerotiorum)* Eastern Filbert Blight (*Anisogramma anomala*) Leaf Rust (*Tranzschelia discolor*) Scab (*Cladosporium carpophilium*) (*Sphaceloma perseae*) Shot Hole (*Wilsonomyces carpophilus*)			
Tropical Fruits, including: Avocado Banana Kiwi Mango Papaya Plantain Pineapple Pomegranate	Anthracnose (*Colletotrichum gloeosporioides*) Bacterial Blight (*Pseudomonas syringae*) (*Pseudomonas viridiflava*) Bacterial Canker (*Xanthomonas campestris*) Botrytis Fruit Rot (*Botrytis cinerea*) Scab (*Elsinoe mangiferae*) Sigatoka (*Mycosphaerella fijiensis*)	Foliar (Ground)	2 - 8 quarts	Apply preventively in 50 – 100 gallons of water when conditions are conducive to disease development. Apply on a 7 – 10 day spray interval or as needed.
		Foliar (Arial)	2 - 8 quarts	For aerial applications, apply this product in a minimum of 10 gallons of water per acre.

Application Rates for Post-Harvest Commodities:

Postharvest crop	Disease	Rate	Notes
Postharvest fruits and vegetables, including: Apples Cherries Citrus Pears Potatoes Sweet potatoes	Blue mold Dry rot Gray mold Green mold Mucor rot Silver scurf Sour rot	2 - 8 quarts per 100 gallons of water	Apply a single application of a 0.5 – 2% concentration (2 - 8 quarts per 100 gallons) to achieve good coverage. The application may be made as a spray, a dip or a wash.

CHEMIGATION USE DIRECTIONS

Apply this product only through sprinkler including center pivot, lateral move, end tow, side (wheel) roll, traveler, big gun, solid set, or hand move irrigation systems. Do not apply this product through any other type of irrigation systems. Do not connect an irrigation system (including greenhouse systems) used for pesticide applications to a public water system.

Spray preparation
First prepare a suspension of ARMOUR-Zen 15% in a mix tank. Fill tank ½ to ¾ the desired amount of water. Start mechanical or hydraulic agitation. Add the required amount of ARMOUR-Zen 15%, and then the remaining volume of water. Then set the sprinkler to deliver a minimum of 0.1 to 0.3 inch of water per acre. Start sprinkler and uniformly inject the suspension of ARMOUR-Zen 15% into the irrigation water line so as to deliver the desired rate per acre. Inject the suspension of ARMOUR-Zen 15% with a positive displacement pump into the main line ahead of a right angle turn to insure adequate mixing. Any questions on calibration should be directed to your State Extension Service Specialists, to equipment manufacturers or other experts.

Do not combine ARMOUR-Zen 15% with pesticides, surfactants or fertilizers for application through chemigation equipment unless prior experience has shown the combination physically compatible, effective and non-injurious under conditions of use. ARMOUR-Zen 15% has not been fully evaluated for compatibility with all adjuvants or surfactants. It is advisable to conduct a spray compatibility test if a mixture with adjuvants or surfactants is planned.

GENERAL PRECAUTIONS FOR APPLICATIONS THROUGH SPRINKLER IRRIGATION SYSTEMS

Maintain continuous agitation in the mix tank during mixing and application to insure a uniform suspension. Greater accuracy in calibration and distribution will be achieved by injecting a larger volume for a more dilute solution per unit time. Crop injury or lack of effectiveness can result from non-uniform distribution of treated water. 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. Allow sufficient time for pesticide to be flushed through all lines and all nozzles before turning off irrigation waters.

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 backflow.

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 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. Do not apply when wind speed favors drift beyond the area intended for treatment.

Do not apply when wind speed favors drift, when system connections or fittings leak, when nozzles do not provide uniform distribution or when lines containing the product must be dismantled and drained.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

Pesticide Storage: Store in a cool, dry place at or below 68°F (20°C). Store in original container only. Keep container tightly closed when not in use.

Pesticide Disposal: Wastes resulting from use of this product must be disposed of on site or at an approved waste disposal facility.

Container Handling: Nonrefillable container. Do not reuse or refill this container. Offer for recycling, if available. Triple rinse container promptly after emptying.

(Containers 5 gallons or less)

Triple rinse as follows: Fill container ¼ full with water and recap. Agitate vigorously. Follow Pesticide Disposal instructions for rinsate disposal. Drain for 10 seconds after the flow begins to drip. Repeat procedure two more times. Then offer for recycling or reconditioning. If not available, puncture and dispose in a sanitary landfill.

(Containers greater than 5 gallons):

Triple rinse as follows: Fill container ¼ full with water. 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. Follow Pesticide Disposal instructions for rinsate disposal. Repeat this procedure two more times. Then offer for recycling or reconditioning. If not available, puncture and dispose in a sanitary landfill.

WARRANTY STATEMENT

Botry-Zen (2010) Limited warrants that this product conformed to its description and was reasonably fit for the purposes stated on the label when used in accordance with Seller's directions. Buyers and users of this product assume the risk of any use contrary to such directions. SELLER MAKES NO OTHER EXPRESS OR IMPLIED WARRANTY OR GARANTEE, INCLUDING ANY OTHER EXPRESS OR IMPLIED WARRANTY OF FITNESS OR OF MERCHANTABILITY AND NO AGENT OF SELLER IS AUTHORIZED TO DO SO. To the extent consistent with applicable law, the Seller's liability for any breach of warranty shall not exceed the purchase price of the material as to which a claim is made.

To the extent consistent with applicable law, Buyers and users of this product are responsible for all loss or damage from use or handling of this product which results from conditions beyond the control of Seller, or without the fault or negligence of the Seller, or from failure to follow the label.

Sublabel B: Home and Garden Use

ARMOUR-Zen 15%®

ACTIVE INGREDIENT:	
Chitosan	15.00%
OTHER INGREDIENTS:	85.00%
TOTAL:	100.00%

Product contains 1.24 lb (560 g) of chitosan per gallon.

KEEP OUT OF REACH OF CHILDREN
CAUTION

FIRST AID	
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 treatment advice.
HOTLINE NUMBER Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-800-222-1222 for emergency medical treatment information.	

See (back) (side) panel for additional precautionary statements and directions for use.

EPA Reg. No.: (Pending as File Symbol 75747-L)
EPA Establishment No.: XXXXX-XX-XX
(**Batch No. / Lot No.:** XXX)

Net Weight: XX lbs (XX kg)

Manufactured by:
Botry-Zen (2010) Limited
156 Frederick Street, P.O. Box 1777
Dunedin 9054
New Zealand
www.botryzen.co.nz

Distributed by:
(U.S. name and address –to be determined)

PRECAUTIONARY STATEMENTS

Hazards to humans and domestic animals - CAUTION. Causes moderate eye irritation. Avoid contact with eyes or clothing. Wear goggles or safety glasses, long sleeved shirt and long pants, gloves and shoes plus socks. 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.

Environmental Hazards: To protect the environment, do not allow pesticide to enter or run off into storm drains, drainage ditches, gutters or surface waters. Applying this product in calm weather when rain is not predicted for the next 24 hours will help to ensure that wind or rain does not blow or wash pesticide off the treatment area. Rinsing application equipment over the treated area will help avoid runoff to water bodies or drainage systems.

DIRECTIONS FOR USE

It is a violation of Federal Law to use this product in a manner inconsistent with its labeling.

HOW IT WORKS

ARMOUR-Zen 15% is chitosan-based product that is antifungal and antibacterial, preventing spore germination and causing existing mycelia to shrink and lose structural integrity. AMOUR-Zen is effective against plant pathogens including powdery and downy mildews, *Botrytis, Phytophthora* spp., leaf spot, early and late blight, anthracnose, stem wilt, damp-off, stem cankering and blast. ARMOUR-Zen 15% can be used throughout your growing season.

HOW TO APPLY

RATE: Mix 8 – 16 teaspoons of ARMOUR-Zen 15% per gallon of water.

MIXING: Dilute ARMOUR-Zen 15% with water and apply in conventional spray equipment. Partially fill the spray tank with clean water. Add the specified amount of ARMOUR-Zen 15% to the tank. Finish filling the tank to the desired volume to obtain the proper spray concentration. Shake the spray tank and use spray mixture immediately. Do not allow spray mixture to stand overnight or for prolonged periods.

APPLICATION: Apply ARMOUR-Zen 15% using spray equipment to the point of saturation. Good coverage and wetting is required. The amount of spray solution to apply will vary depending on the type of crop. Apply in sufficient water to achieve thorough coverage. Repeat at 7 – 10 day intervals as needed. ARMOUR-Zen 15% can be applied in commonly used pressurized hand-held sprayers, spray trigger bottles and hose-end sprayers.

WHERE TO APPLY

Apply to the following types home and garden plants to control mildews, blights,

spots and other common plant diseases:

Garden plants (including):
Asparagus, beets, broccoli, Brussels sprouts, cabbage, carrots, cane fruit (raspberry, blackberry, etc.) cauliflower, celery, collards, cucumbers, edible-podded legume vegetables including: snap bean, wax bean, yard long bean, jack bean, edible-pod pea, snow pea, sugar snap pea; dried shelled beans and peas including: field bean, kidney bean, lima bean (dry), navy bean, pinto bean, adzuki bean, black-eyed pea, cowpea, mung bean, southern pea, lentil (dry); eggplant, grapes, herbs, horseradish, kale, lettuce, melons, mustard greens, onions, parsnips, pepper, potatoes, radish, rutabaga, salsify, squash (winter and summer), sweet potato, strawberry, tomatoes, turnip greens, and turnips.

Ornamentals-including annuals and perennials

Fruit and Nut Trees

Turf

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.
Pesticide Storage: Store in a cool dry place inaccessible to children.
Pesticide Disposal and Container Handling: If empty: Nonrefillable container. Do not reuse or refill this container. Place in trash and offer for recycling if available. **If partially filled:** Call your local solid waste agency or (800) 858-7378 (National Pesticide Information Center) for disposal instructions. Never place unused product down any indoor or outdoor drain.

81045-2 04124120009

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

1/8

Mr. Bruce Jaeger
Plant Defense Boosters, Inc.
c/o Health and Environmental Horizons, LTD
2851 South Haven Road
Annapolis, MD 21401

APR 24 2009

Subject: Plant Defense Boosters, Inc.; ELEXA 4
EPA Registration No. 81045-2
Label and CSF Amendment with Data (New Source of Active Ingredient); B680
D# 403804, Application Dated 1/13/9

Dear Mr. Jaeger:

The amendment referred to above, submitted in connection with registration under FIFRA section 3(c)(7)(A), is acceptable provided that you:

1. Submit and/or cite all data required for registration/reregistration of your product under FIFRA section 3(c)(5) when the Agency requires all registrants of similar products to submit such data.

2. Submit two (2) copies of your final printed labeling before you release the product for shipment. Final printed labeling means the label or labeling of the product when distributed or sold. Clearly legible reproductions or photo reductions will be accepted for unusual labels, such as those silk-screened directly onto glass or metal containers or large bags or drum labels.

If these conditions are not complied with, the registration will be subject to cancellation in accordance with FIFRA section 6(b). Your release for shipment of the product bearing the amended labeling constitutes acceptance of these conditions.

If you have any questions contact Chris Pfeifer at 703-308-0031 or by email at: pfeifer.chris@epa.gov. A stamped copy of the label is enclosed for your records.

Sincerely,

Linda A. Hollis, Chief
Biochemical Pesticides Branch
Biopesticides and Pollution
Prevention Division (7511P)

Enclosure

CONCURRENCES								
SYMBOL ▶	7511P							
SURNAME ▶	PFEIFER							
DATE ▶	4/16/9							

EPA Form 1320-1A (1/90) *Printed on Recycled Paper* **OFFICIAL FILE COPY**

* U.S. Government Printing Office: 2005 206-899 (mac)

ELEXA® 4
PLANT DEFENSE BOOSTER

ACTIVE INGREDIENT:	% w/w
Chitosan (poly-D-glucosamine)*	3.96%
OTHER INGREDIENTS:	96.04%
Total	100.0%

* Contains 0.32 pounds of active ingredient per gallon of product (equivalent to 38 grams of active ingredient per liter of product)

KEEP OUT OF REACH OF CHILDREN

CAUTION

FIRST AID STATEMENTS	
IF ON SKIN OR CLOTHING	o Take off contaminated clothing. o Rinse skin immediately with plenty of water for 15-20 minutes. o Call a poison control center or doctor for treatment advice.
IF IN EYES	o Hold eye open and rinse slowly and gently with water for 15-20 minutes. o Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. o Call a poison control center or doctor for treatment advice.

Hotline Number

Have the product container or label with you when calling a poison control center or doctor, or going for treatment. For emergency information concerning this product, call the National Pesticides Information Center (NPIC) at 1-800-858-7378 seven days a week, 6:30 am to 4:30 pm Pacific Time (NPIC Web site: www.npic.orst.edu)

See side/back panels for additional precautionary statements

EPA Reg. No. 81045-2
EPA Est. No.61842-CA-001

ACCEPTED
APR 24 2009
Under the Federal Insecticide, Fungicide, and Rodenticide Act, as amended, for the pesticide registered under EPA Reg. No. 81045-2

Net Contents: 2.5 Gallons

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION: Causes moderate eye irritation. Avoid contact with skin, eyes or clothing. Wash thoroughly with soap and water after handling and before eating, drinking, chewing gum or using tobacco. Remove and wash contaminated clothing before reuse. Wear the appropriate Personal Protective Equipment (PPE)

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Applicators, mixers, loaders and other handlers must wear:

- Long-sleeved shirt and long pants.
- Shoes plus socks.
- Waterproof gloves.
- Protective eyewear.

Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables, use detergent and hot water. Keep and wash PPE separately from other laundry.

USER SAFETY RECOMMENDATIONS

Users should:

- Remove clothing immediately if pesticide gets 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

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 cleaning equipment or disposing of equipment washwaters or rinsate. Do not allow runoff into lakes, streams, ponds or public waterways.

PHYSICAL OR CHEMICAL HAZARDS

For spill, leak, fire, exposure, or accident call CHEMTREC at 1-800-424-9300.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling. 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. For any requirements specific to your State or Tribe, consult the State or Tribal agency responsible for pesticide regulation.

ELEXA-4 is a Plant Defense Booster. The active ingredient in ELEXA-4 is derived from basic carbohydrate sources. Application of ELEXA-4 elicits phytoalexins in the plant's defense system, protecting against certain plant pathogens.

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 interval. 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.

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:

- o Coveralls
- o Waterproof gloves
- o Shoes plus socks

NON-AGRICULTURAL USE REQUIREMENTS

The requirements in this box apply to uses of this product that are NOT within the scope of the Worker Protection Standard for agricultural pesticides (40 CFR Part 170). The WPS applies when this product is used to produce agricultural plants on farms, forests, nurseries, and greenhouses. Do not enter treated area without protective clothing until sprays have dried.

MIXING AND APPLICATION INSTRUCTIONS

ELEXA-4 is an aqueous product. Mix ELEXA-4 with clean water at the rate shown in the use directions below. To prepare the solution, add one half the total amount of water, add the desired volume of ELEXA-4 and complete with water to the total volume required. Addition of a food use surfactant improves adhesion and provides superior results. The pH of the final solution should be between 5.7 and 6.3 for optimum results.

Early-season Applications - Apply ELEXA-4 with lower volumes of water in the early stages of plant growth This stage occurs from planting, or bud break in annuals, through early stages of leaf growth and expansion. For lower volumes of spray, such as 25 gallons per acre (gpa), dilute ELEXA-4 in water at a ratio as low as 1 part ELEXA-4 to 19 parts water (a final tank mix ratio of 1:20). For higher spray volumes up to 100 gpa, dilute ELEXA-4 in water at a ratio of 1 part ELEXA-4 up to 39 parts water (a final tank mix ratio of 1:40). As an example, use 2.5 gallons of ELEXA-4 in 97.5 gallons of water for a final spray

volume of 100 gpa. Increase the rate of ELEXA-4 to the concentrations shown below if disease pressure becomes severe. Apply ELEXA-4 on a 7-14 day schedule depending upon disease pressure.

Mid-season Applications - During mid-season, increase application rates of ELEXA-4 as the amount of water applied increases. During this stage, plants are growing actively with continued leaf expansion, but prior to the later stages of the plant's development. The ELEXA-4 rate will vary depending upon the type of plant, spray equipment used and grower's standard practices. Dilute ELEXA-4 in water at a ratio of between 1 part ELEXA-4 and 19 to 39 parts water. As an example, it is generally recommended that ELEXA-4 be applied at a rate of 2.5 gallons in 100 gallons of final spray volume (2.5% ELEXA-4 or 0.1% a.i. per acre on a v/v basis). As in early-season applications, use higher rates of ELEXA-4 when disease pressure is highest, e.g. up to 5.0 gallons in 100 gallons of final spray volume. Apply ELEXA-4 on a 7-14 day schedule depending upon disease pressure.

Late-season Applications - During the latter part of the growing season when the plant's canopy is fully expanded and it is more difficult to get full coverage, higher volumes of water will be needed. ELEXA-4 can be diluted in water at a ratio of between 1 part ELEXA-4 and 29 to 39 parts water. Again, use higher rates if disease pressure is high. The maximum rate to use during late-season applications is 7.5 gallons of ELEXA-4 in 300 gallons of final spray volume, or 1 part ELEXA-4 in 39 parts water. Apply ELEXA-4 on a 7-14 day schedule depending upon disease pressure.

Cleaning Application Equipment

To prevent contamination of the dilute solution of ELEXA-4 by possible pesticides or other chemical residues in the spraying equipment, make sure that the equipment is thoroughly clean before and after use.

Special Application Rate Table for use on Grapes[1]

Season and Growth Stage of Plant	Final Spray Volume (gpa)	Volume of ELEXA In Tank (gpa)	Ratio of ELEXA to water in Final Spray Tank	Amount of A.I. per acre (lbs)
Early season (young plants with limited growth	25 to 100	1.25 to 2.5	1:20 to 1:40	0.4 to 0.8
Mid-season (plants in active growth stage)	75 to 150	2.5 to 3.75	1:20 to 1:40	0.8 to 1.2
Late-season (canopy of plant fully expanded)	125 to 300	3.0 to 7.5	ca 1:40	0.96 to 2.4

[1]The concept used in calculating rates to be applied on grapes is used on other crops below.

Crops, Rates and Diseases which ELEXA 4 Provides Protection Against

Crops	Rate of ELEXA	Protection Against The Following Diseases	Specific Instruction (also refer to Mixing and Application Instructions)
Tree Fruit: Apples Cherries Grapefruit Lemons Limes Nectarines Oranges Peaches Pears Plums Prunes Tangerines	1.25 - 7.5 gal/acre (0.4 - 2.4 lbs a.i./acre) in Final spray volume of 25 to 300 gal*/acre *Adjust application rate depending upon tree size, size of leaves and spray equipment used.	Powdery Mildew (various species)	Apply diluted spray at a rate of at least 25 gal/acre using conventional spray equipment. Apply ELEXA-4 before disease symptoms appear. Repeat applications on 7-14 day intervals.
Vegetables: Beans Carrots Cucumbers Eggplant Garlic Ginseng Herbs Leeks Lentils Lettuce Melons Onions Peas Peppers Potatoes Pumpkins Squash Strawberries Sweet Potatoes Tomatoes	1.25 - 5.0 gal/acre (0.4 - 1.6 lbs a.i./acre) in Final spray volume of 25 to 200 gal*/acre * Adjust application rate depending upon tree size, size of leaves and spray equipment used.	Powdery Mildew (various species) Downy Mildew (various species) Early Blight, Late Blight (Phytophthora infestans) Gray Mold (Botrytis cineria)	Apply diluted spray at a rate of at least 25 gal/acre using conventional spray equipment. Apply ELEXA-4 before disease symptoms appear. Repeat applications on 7-10 day intervals.
Grapes	1.25 - 7.5 gal/acre (0.4 - 2.4 lbs a.i./acre) in Final spray volume of 25 to 300 gal*/acre * Adjust application rate depending upon tree size, size of leaves and spray equipment used.	Powdery Mildew (various species) Downy Mildew (various species)	Apply diluted spray at a rate of at least 25 gal/acre using conventional spray equipment. Apply ELEXA-4 before disease symptoms appear. Repeat applications on 7-14 day intervals. Higher final spray volumes and higher rates of ELEXA-4 are recommended on table grapes as plant canopies tend to be larger than on wine grapes.

Greenhouse and Nursery Plants: Potted plants Flowers (roses, etc) Vegetables Herbs Shrubs Fruit trees	1.25 - 5.0 gal/acre (0.4 - 1.6 lbs a.i./acre) in Final spray volume of 25 to 200 gal*/acre * Adjust application rate depending upon tree size, size of leaves and spray equipment used.	Powdery Mildew (various species) Downy Mildew (various species) Gray Mold (Botrytis cineria)	Apply diluted spray at a rate of at least 25 gal/acre using conventional spray equipment. Apply ELEXA-4 before disease symptoms appear. Repeat applications on 7 day intervals as needed.
Turf: Bent grass Bermuda grass Bluegrass Centipede grass Dichondra Fescue Rye grass Wheat grass Zoysia grass St. Augustine	1.25 - 5.0 gal/acre (0.4 - 1.6 lbs a.i./acre) in Final spray volume of 25 to 200 gal*/acre * Adjust application rate depending upon tree size, size of leaves and spray equipment used.	Powdery Mildew (various species) Leaf Spot Anthracnose	Apply diluted spray at a rate of at least 25 gal/acre using conventional spray equipment. Apply ELEXA-4 before disease symptoms appear. Repeat applications on 7 day intervals as needed.
Grain crops: Barley Oats Rice Wheat	1.25 - 5.0 gal/acre (0.4 - 1.6 lbs a.i./acre) in Final spray volume of 25 to 200 gal*/acre * Adjust application rate depending upon tree size, size of leaves and spray equipment used.	Sheath Blight Powdery Mildew (various species) Blast	Apply diluted spray at a rate of at least 25 gal/acre using conventional spray equipment. Apply ELEXA-4 before disease symptoms appear. Repeat applications on 7 day intervals as needed.

GREENHOUSE USE

Use ELEXA-4 as directed for greenhouses. Prepare the spray mixture using one (1) part ELEXA-4 with nineteen (19) parts of water. Spray until plant runoff.

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.

Pesticide Storage: Store in a cool dry place. Avoid freezing.

Pesticide Disposal: To avoid wastes, use all material in this container by application according to label directions. If wastes cannot be avoided, offer remaining product to a waste disposal facility or pesticide disposal program (often such programs are run by state or local governments or by industry).

Do not contaminate water when disposing of equipment washwater or rinsate. Pesticide wastes may be toxic. Improper disposal of unused pesticide, washwater or rinse water is

a violation of federal law.

Container Disposal: Non-refillable container. Do not reuse or refill this container 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 if available, or puncture and dispose of in a sanitary landfill or by incineration. Do not burn unless allowed by state and local ordinances.

WARRANTY

Plant Defense Boosters, Inc. warrants that the product conforms to its chemical description and is reasonably fit for the purpose stated on the label only when used in accordance with the label directions under normal conditions of use. Plant Defense Boosters, Inc. makes no other express or implied warranties either of merchantability or fitness for a particular use. Handling, storage and use of the product by Buyer or User are beyond the control of Plant Defense Boosters, Inc. and Seller. To the extent permitted by applicable law, risks such as ineffectiveness or other unintended consequences resulting from, but not limited to, failure to follow label directions will be assumed by the Buyer or User.

The terms of this Limited Warranty and Disclaimer cannot be varied by any written or verbal statements or agreements. No employee or agent of the seller is authorized to vary or exceed the terms of this Limited Warranty and Disclaimer in any manner.

Manufactured in U.S.A. by:
Plant Defense Boosters, Inc.
235 Harrison Street
Syracuse, New York 13210
315-472-1601

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF CHEMICAL SAFETY
AND POLLUTION PREVENTION

October 4, 2019

Craig Bosarge
Agent for AgNubio, Inc.
c/o SmithBosarge LLC
2323 Clear Lake City Blvd. #194
Houston, TX 77062

Subject: Non-PRIA (Pesticide Registration Improvement Act) Labeling Amendment – Acceptable Address Change and Addition of Organic Logo and Batch Code Placeholder
Product Name: BioRend
EPA Registration Number: 91664-1
Application Date: 08/03/2019
OPP Decision Number: 554119

Dear Mr. Bosarge:

The amended labeling referred to above, submitted in connection with registration under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), as amended, is acceptable.

This approval does not affect any terms or conditions that were previously imposed on this registration. You continue to be subject to existing terms or conditions on your registration and any deadlines connected with them.

A stamped copy of your labeling is enclosed for your records. This labeling supersedes all previously accepted labeling. You must submit one (1) copy of the final printed labeling before you release this product for shipment with the new labeling. In accordance with 40 CFR § 152.130(c), you may distribute or sell this product under the previously approved labeling for 18 months from the date of this letter. After 18 months, you may only distribute or sell this product if it bears this new revised labeling or subsequently approved labeling. "To distribute or sell" is defined under FIFRA section 2(gg) and its implementing regulation at 40 CFR § 152.3.

Should you wish to add/retain a reference to your company's website on your label, then please be aware that the website becomes labeling under FIFRA and is subject to review by the U.S. Environmental Protection Agency (EPA). If the website is false or misleading, the product will be considered to be misbranded and sale or distribution of the product is unlawful under FIFRA section 12(a)(1)(E). 40 CFR § 156.10(a)(5) lists examples of statements the EPA may consider false or misleading. In addition, regardless of whether a website is referenced on your product's label, claims made on the website may not substantially differ from those claims approved through the registration process. Therefore, should the EPA find or if it is brought to our attention that a website contains false

or misleading statements or claims substantially differing from the EPA-approved registration, the website will be referred to the EPA's Office of Enforcement and Compliance Assurance.

Your release for shipment of this product constitutes acceptance of these terms. If these terms are not complied with, this registration will be subject to cancellation in accordance with FIFRA section 6.

If you have any questions, please contact Anna O'Neil by phone at (703) 347-8274 or via email at oneil.anna@epa.gov.

Sincerely,

Andrew Bryceland, Team Leader
Biochemical Pesticides Branch
Biopesticides and Pollution
Prevention Division (7511P)
Office of Pesticide Programs

Enclosure

BIOREND®

Plant Defense Booster

ACCEPTED
10/04/2019
Under the Federal Insecticide, Fungicide and Rodenticide Act as amended, for the pesticide registered under EPA Reg. No. 91664-1

BIOREND® is a registered trademark of BioAgro, SA

ACTIVE INGREDIENT:

Chitosan (poly-D-glucosamine)*	2.5%
OTHER INGREDIENTS:	97.5%
Total	100.0%

*Contains 0.22 pounds of active ingredient per gallon of product (equivalent to 26 grams of active ingredient per liter of product)

KEEP OUT OF REACH OF CHILDREN

CAUTION

OMRI LISTED® For Organic Use

EPA Reg. No. 91664-1
EPA Est. No. _____
{Lot # to be printed on bottle}

Net Contents: _____

FOR ORGANIC PRODUCTION

Manufactured For:
Ag NuBio, Inc.
10300 Sunset Dr., Suite 179
Miami, FL 33173

See side/back panels for additional precautionary statements.

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION: Wear the appropriate Person Protective Equipment (PPE)

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Applicators, mixers, loaders and other handlers must wear:

- Long-sleeved shirt and long pants.
- Shoes plus socks.

Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables, use detergent and hot water. Keep and wash PPE separately from other laundry.

USER SAFETY RECOMMENDATIONS

Users should:

- Remove clothing immediately if pesticide gets 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

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 cleaning equipment or disposing of equipment wash waters or rinsate. Do not allow runoff into lakes, streams, ponds or public waterways.

PHYSICAL OR CHEMICAL HAZARDS

For spill, leak, fire, exposure, or accident call CHEMTREC at 1-800-424-9300.

DIRECTIONS FOR USE

It is a violation of federal law to use this product in a manner inconsistent with its labeling. 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. For any requirements specific to your state or tribe, consult the agency responsible for pesticide regulation.

BIOREND® is a Plant Defense Booster and should always be used in conjunction with an EPA registered insecticide, fungicide, nematicide or plant growth regulator. The active ingredient in BIOREND® is derived from a basic carbohydrate source. Application of BIOREND® elicits phytoalexins in the plant's defense system protecting against certain plant pathogens.

BIOREND® stimulates the growing of roots and culms by using the SAR (Systemic Acquired Resistance) mechanism, which allows plants to explore a greater volume of soil and, therefore, to absorb more water and nutrients, to become stronger and healthier, less susceptible to attacks on the root system, to allow the healing of wounds, to reduce post-transplanting dehydration in sowing and transplanting species.

When used as directed on this label BIOREND® can boost seed germination and vitality, stimulate emergence and sprouting, enhance plant vigor, promote root growth, promote foliar growth, increase crop yields, improve crop vigor and quality, aid in suppression of diseases and pathogens, activate plant resistance to environmental stress, drought and disease pressure, including the suppression of plant parasitic nematodes.

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 labels about personal protective equipment (PPE) and restricted-entry interval. 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.

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
- Waterproof gloves
- Shoes plus socks

NON-AGRICULTURAL USE REQUIREMENTS

The requirements in this box apply to uses of this product that are NOT within the scope of the Worker Protection Standard for agricultural pesticides (40 CFR Part 170). The WPS applies when this product is used to produce agricultural plants on farms, forests, nurseries, and greenhouses.

Do not enter treated area without protective clothing until sprays have dried.

MIXING AND APPLICATION INSTRUCTIONS

Preparation of sprays: Fill the application container up to 1/3 of its capacity. Add BIOREND® according to the recommended dose with the agitation system on and make up to volume with water. To improve solution of water and BIOREND®, use water of pH 6.5 or lower. If pH of the water is over 6.5, use a buffer to reduce pH to 6.5.

Compatibility: To determine the physical compatibility of BIOREND® with any other product, use a small container to mix a small amount (e.g. 1 pint) of spray solution, containing all ingredients in the same order and ratio as the anticipated use. If any indication of physical incompatibility develops, do not use this mixture for spraying. Indications of incompatibility usually appear within 5-15 minutes after mixing. Read and follow all directions and precautions on this label and on the other labels of any products for which a tank mixture is being considered. To improve compatibility, use water of pH 6.5 of lower. If pH of the water is over 6.5, use a buffer to reduce pH to 6.5. When mixing with other products, add the other product(s) to water of pH 6.5 or lower and add the BIOREND® to the mixture last.

Phytotoxicity: BIOREND® is not phytotoxic in the labeled applications doses and crops.

Chemigation Directions:

"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 backflow."

"The pesticide injection pipeline must contain a function, 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, inter-locking 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."

Use a pesticide supply tank for the mixing and application of BIOREND® in chemigation systems.

Remove scale, pesticide residues, and other foreign matter from the chemical tank and entire injector system. Flush with clean water.

First prepare a suspension of BIOREND® in the supply tank by filling the tank with ½ to ¾ the desired amount of water. Start mechanical of hydraulic agitation. Add the required amount of BIOREND® and then the remaining volume of water. When mixing with other products, add the other product(s) to water of pH 6.5 of lower and add the BIOREND® to the mixture last. The suspension of BIOREND® must be injected with a positive displacement pump into the main line ahead of a right angle turn to insure adequate mixing.

Maintain continuous agitation in the supply tank during mixing and application to assure a uniform suspension.

For center pivot and other continuously moving sprinkler systems, set system to apply 0.1 to 0.3 inches of water with the required amount of mixture evenly and continuously throughout the irrigation cycle.

For solid set, wheel-line, drip, micro sprinkler or other stationery system applications, introduce the correct amount of BIOREND® mixture from the supply tank into the irrigation water during the middle one-third of the irrigation cycle.

Cleaning Application Equipment

To prevent contamination of the dilute solution of BIOREND® by possible pesticides or other chemical residues in the spraying equipment, make sure that the equipment is thoroughly clean before and after use.

Use Rates, Crops, Application Timing and Method

Crop	BIOREND® Use Rate	Number of Applications	Application Time	Application Methods
Corn, Cotton, Soybeans, Peanuts	0.5 Gallons/Acre (0.11 lbs. ai./acre)	4-6	In-furrow at planting followed by foliar sprays every 7 to 14 days beginning at V3 on corn, V2/V3 on cotton, R2 on soybean and pegging on peanuts.	Foliar Spray and/or In-Furrow
Grapes, Kiwi, Lemons, Oranges, Clementine, Grapefruit, Limes, Tangerines, Peaches, Apricot, Nectarines, Cherry, Apple, Pear, Olive,	New Plantings 1.1 Gallons/acre (0.24 lbs. ai./acre) Mature Plantings 2.1 Gallons/acre (0.46 lbs. ai./acre)	1 – 2 Depending on the general condition of the plants	At peak activity in the roots	Inject into drip or sprinkler irrigation system

Blueberry, Raspberry, Blackberry, Avocado, Walnut, Almond, Hazelnut				
Strawberry	½ gallon/acre (0.11 lbs. ai./acre)	2 – 4	At peak activity in the roots	Inject into drip or sprinkler irrigation system
Potato	0.8 gallons/acre (0.19 lbs. ai./acre)	4	Every 10 days, starting 30 days after planting	Inject into drip or sprinkler irrigation system
Garlic	5% by volume mixture (64 fluid ounces/10 gallons mixture) (0.11 lbs. ai./10 gallons mixture)	1	Seed	Immerse seed in solution for 15 minutes prior to planting
Onion Transplant production	1% by volume mixture (12.8 fluid ounces/10 gallons mixture) (0.022 lbs. ai./10 gallons)	3	Make weekly applications starting 30 days prior to transplanting.	Sprinkle soil to wet surface or seedling to point of runoff
Onion Transplanting	5% by volume mixture (38.4 fluid ounces/10 gallons mixture) (0.066 lbs. ai./10 gallons)	1	Transplanting	Immerse roots in mixture for 30 seconds prior to transplanting
Greenhouse Tomato	1.5% by volume mixture (19.2 fluid ounces/10 gallons mixture) (0.033 lbs. ai./10 gallons mixture)	1	Seed	Immerse seeds in mixture for 30-second prior to planting
	0.54 to 1.1 gallons/acre (0.12 to 0.24 lbs. ai/acre	4	Apply every 7 days starting 10 days after planting	Inject into drip or sprinkler irrigation system
	1.1 to 1.6 gallons/acre 1.2 (0.24 to 0.35 lbs. ai/acre	4	Apply every 7 days starting at beginning of physiological maturity	Inject into drip or sprinkler irrigation system
Grapes	0.55 to 1.41 Gallons/Acre	5 – 6	2 apps at 20 cm shoots then 3 to 4 apps from	Foliar spray

	(0.12 to 0.31 lbs. ai./acre)		fruit set up to 20 days before harvest	
Kiwi	0.55 to 1.1 Gallons/Acre (0.12 to 0.24 lbs. ai./acre)	5 – 6	2 apps at 20 cm shoots then 3 to 4 apps from fruit set up to 20 days before harvest	Foliar spray
Lemon, Orange, Clementine, Grapefruit, Lime, Tangerine	0.55 to 1.1 Gallons/Acre (0.12 to 0.24 lbs. ai./acre)	3 – 4	Spring - Summer	Foliar spray
Peach, Apricot, Nectarine, Cherry, Plum, Prune, Olive	0.55 to 1.1 Gallons/Acre (0.12 to 0.24 lbs. ai./acre)	3 – 4	Starting at Bloom and every 7 days, up to 4 applications	Foliar spray
Apple, Pear	0.55 to 1.1 Gallons/Acre (0.12 to 0.24 lbs. ai./acre)	3 – 4	One fruit application at fruit set. Then starting in mid-June every 10 days up to 4 applications	Foliar spray
Blueberry, Raspberry, Blackberry	0.55 to 1.1 Gallons/Acre (0.12 to 0.24 lbs. ai./acre)	3 – 4	From sprouting up to fruit-set	Foliar spray
Walnut, Almond, Hazelnut	0.55 to 1.1 Gallons/Acre (0.12 to 0.24 lbs. ai./acre)	4 – 6	Start in bloom with female flower exposed Repeat every 7 to 10 days	Foliar spray
Beans, Carrots, Celery, Cucumbers, Eggplant, Garlic, Ginseng, Herbs, Leek, Lentils, Lettuce, Melons, Onions, Peas, Peppers, Potatoes, Pumpkins,	0.55 to 1.1 Gallons/Acre (0.12 to 0.24 lbs. ai./acre)	4 – 6	Start 25 days after transplanting. Repeat every 10 days up to 6 applications	Foliar Spray

Squash, Strawberries, Sweet Potato, Tomatoes				
Lettuce, including leaf and head lettuce	0.55 to 1.41 Gallons/Acre (0.12 to 0.31 lbs. ai./acre)	4 – 6	Start 25 days after transplanting. Repeat every 10 days up to 6 applications	Foliar Spray
<u>Greenhouse and Nursery Plant:</u> Flowers (roses, etc) Vegetables, Herbs, Shrubs, Fruit Trees, Vines, Avocado	1% by volume mixture (12.8 fluid ounces/10 gallons mixture) (0.022 lbs. ai./10 gallons)	4 – 6	Apply every 7 days up to 6 applications	Foliar spray to run-off (25 to 200 gallons / acre). (0.06 to 0.44 lbs. ai/acre)
<u>Nurseries</u> Eucalyptus and Pine Trees	5% by volume mixture (0.5 gallons/10 gallons mixture) (0.11 lbs. ai./10 gallons)	2	30 and 60 days after emergence	Foliar spray 0.35 fluid ounces of 5% mixture/plant
Eucalyptus transplants	15% by volume mixture (1.5 gallons/10 gallons mixture) (0.33 lbs. ai./10 gallons)	1	Transplanting	Dip roots of seedlings in mixture prior to transplanting
Pine tree transplants	20% by volume mixture (2 gallons/10 gallons mixture) (0.44 lbs. ai./10 gallons)	1	Transplanting	Dip roots of seedlings in mixture prior to transplanting
<u>Turf:</u> Bent grass Bermuda grass Bluegrass Centipede grass Dichondra Fescue Rye grass Wheat grass Zoysia grass St. Augustine	0.55 to 1.1 Gallons/Acre (0.12 to 0.24 lbs. ai./acre)	4 – 6	When grass is actively growing Repeat applications on 7 day intervals as needed	Inject into irrigation line or apply as a Foliar Spray

Cereal Grains: Barley Oats Rice Wheat	0.55 to 1.1 Gallons/Acre (0.12 to 0.24 lbs. ai./acre)	4 – 6	Begin prior to period of normal disease development Repeat on 7 day intervals as needed	Inject into irrigation line or apply as a Foliar Spray
Sorghum	0.55 to 1.1 Gallons/Acre (0.12 to 0.24 lbs. ai./acre)	2 – 6	Begin prior to period of normal disease development. Repeat on 7 day intervals as needed.	Inject into irrigation line or apply as a Foliar Spray

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.

Pesticide Storage: Store in a cool dry place. Avoid freezing.

Pesticide Disposal: To avoid wastes, use all material in this container by application according to label directions. If wastes cannot be avoided, offer remaining product to a waste disposal facility or pesticide disposal program (often such programs are run by state or local government or by industry).

Do not contaminate water when disposing of equipment wash water or rinsate. Pesticide wastes may be toxic. Improper disposal of unused pesticide, wash water or rinse water is a violation of federal law.

Container Handling: Nonrefillable Container (five gallons or less): Nonrefillable container. Do not reuse or refill this container. Offer for recycling, if available. Clean container 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 1/4 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 if available or reconditioning if appropriate or puncture and dispose of in a sanitary landfill or by other procedures approved by state and local authorities.

Nonrefillable Container (greater than five gallons): Nonrefillable container. Do not reuse or refill this container. Offer for recycling, if available. Clean container promptly after emptying. Triple rinse as follows: Empty the remaining contents into application equipment or a mix tank. Fill the container 1/4 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 more times. Then offer for recycling if available or reconditioning if appropriate or puncture and dispose of in a sanitary landfill or by other procedures approved by state and local authorities

Warranty Statement

Ag NuBio warrants that this product conforms to the chemical description on the label thereof and is reasonably fit for purposes stated on such label only when used in accordance with directions under normal use conditions. It is impossible to eliminate all risks inherently associated with use of this product. Crop injury, ineffectiveness or other unintended consequences may result because of such factors as weather conditions, presence of other materials or the manner of use or application, all of which are beyond the control of Ag NuBio. To the extent consistent with applicable law, Ag NuBio shall not be liable for consequential, special or indirect damages resulting from the use or handling of this product. All such risks shall be assumed by the Buyer. To the extent consistent with applicable law, the exclusive remedy of any buyer or user of this product

for any and all losses, injuries, or damages resulting from or in any way arising from the use, handling, or application of this product, whether in contract, warranty, tort, negligence, strict liability, or otherwise, shall not exceed the purchase price paid for this product or at Ag NuBio election, the replacement of this product. Ag NuBio MAKES NO WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR ANY OTHER EXPRESS OR IMPLIED WARRANTY EXCEPT AS STATED ABOVE.

OFFICE OF CHEMICAL SAFETY AND POLLUTION PREVENTION

WASHINGTON, D.C. 20460

May 09, 2025

Jeffrey Currie
jcurrie@springregulatory.com
AG NUBIO, INC.

Subject: Non-PRIA (Pesticide Registration Improvement Act) Labeling Amendment - Revision to update application instructions.
Product Name: NUPRO
Admin Number: 91664-3
EPA Receipt Date: 03/20/2025
Action Case Number: 00651790

Dear Jeffrey Currie:

The amended labeling referred to above, submitted in connection with registration under the Federal Insecticide, Fungicide, and Rodenticide Act, as amended, is acceptable.

This approval does not affect any terms or conditions that were previously imposed on this registration. You continue to be subject to existing terms or conditions on your registration and any deadlines connected with them.

A stamped copy of your labeling is enclosed for your records. This labeling supersedes all previously accepted labeling. You must submit one (1) copy of the final printed labeling before you release this product for shipment with the new labeling. In accordance with 40 CFR § 152.130(c), you may distribute or sell this product under the previously approved labeling for 18 months from the date of this letter. After 18 months, you may only distribute or sell this product if it bears this new revised labeling or subsequently approved labeling. “To distribute or sell” is defined under FIFRA section 2(gg) and its implementing regulation at 40 CFR § 152.3.

The label submitted with the application has been stamped "Accepted Only Indicated Revisions Reviewed" and is enclosed for your records.

Should you wish to add/retain a reference to your company’s website on your label, then please be aware that the website becomes labeling under FIFRA and is subject to review by EPA. If the website is false or misleading, the product will be considered to be misbranded and sale or distribution of the product is unlawful under FIFRA section 12(a)(1)(E). 40 CFR § 156.10(a)(5) lists examples of statements the EPA may consider false or misleading. In addition, regardless of whether a website is referenced on your product’s label, claims made on the website may not substantially differ from those claims approved through the registration process. Therefore, should the EPA find or if it is brought to our attention that a website contains statements or claims substantially differing from statements or claims made in connection with obtaining a FIFRA section 3 registration, the website will be referred to the EPA’s Office of Enforcement and Compliance Assurance.

Your release for shipment of this product constitutes acceptance of these terms. If these terms are not complied with, this registration will be subject to cancellation in accordance with FIFRA section 6.

If you have questions, please contact Cecilia Kujawa via email at kujawa.cecilia@epa.gov.

Sincerely,

James Parker, Team Leader
BPB, BPPD
Office of Pesticide Programs

Master Label containing:
Sublabel A: Agricultural Seed Treatment Use
Sublabel B: Ornamental, Field, and Nursery Use
Sublabel C: Home & Garden Use

NuPro™

Agricultural, Ornamental, Nursery and Home & Garden Use

[ABN: YEA!®, YEA!® for Seeds, YEA!® for Trees, YEA!® for Crops, ODC Professional Foliar & Irrigation™, ECOSEED™, ODC Home & Garden™, YEA® Seed Coating; Corn, YEA® Seed Coating: Soybean, YEA® Seed Coating: Wheat, YEA® Seed Coating: Sugar beet, YEA® Seed Coating: Potato, YEA® Seed Coating: Vegetables, NuPro™ ST Seed Treatment, NuStar™, WinSar™, EXCEED™SAR Plant Defense Booster]

ACCEPTED
ONLY INDICATED
REVISIONS REVIEWED
05/09/2025

Under the Federal Insecticide, Fungicide and Rodenticide Act as amended, for the pesticide registered under EPA Reg. No.
91664-3
No label revisions other than those indicated were reported to the Agency.

EXCEED™ is a trademark of Visjon Biologic
NuPro™, NuSar™, and WinSar™ are trademarks of Ag Nubio

Refer to Accompanying Label Booklet for Complete Use Direction

ACTIVE INGREDIENT:

Chitosan	0.25%
OTHER INGREDIENTS:	99.75%
Total	100.00%

Product contains 0.021 lb (0.01 kg) for chitosan/gallon

KEEP OUT OF REACH OF CHILDREN

CAUTION

SEE SIDE PANEL FOR PRECAUTIONARY STATEMENTS

EPA Reg. No. 91664-3
EPA Est. No. _____

Manufactured By:
Ag NuBio, Inc.
10300 Sunset Dr., Suite 179
Miami, FL 33173

Sublabel A: Agricultural Seed Treatment Use

NuPro™

Agricultural Use

[ABN: YEA!®, YEA!® for Seeds, YEA!® for Trees, YEA!® for Crops, ODC Professional Foliar & Irrigation™, ECOSEED™, ODC Home & Garden™, YEA® Seed Coating; Corn, YEA® Seed Coating: Soybean, YEA® Seed Coating: Wheat, YEA® Seed Coating: Sugar beet, YEA® Seed Coating: Potato, YEA® Seed Coating: Vegetables, NuPro™ ST Seed Treatment, NuStar™, WinSar™, EXCEED™SAR Plant Defense Booster]

EXCEED™ is a trademark of Visjon Biologic
NuPro™, NuSar™, and WinSar™ are trademarks of Ag Nubio

FOR ORGANIC PRODUCTION

When used as directed on this label, NuPro™ can boost seed germination and vitality, stimulate emergence and sprouting, enhance plant vigor, promote root growth, promote foliar growth, increase crop yields, improve crop vigor and quality, suppress diseases and pathogens, activate plant resistances to environment stress, drought, and disease pressures, including the suppression of plant parasitic nematodes.

Systemic Induced Resistance and Innate Immunity Protection. NuPro Protects grasses, grains, cereals, legumes, sugar beets, and vegetables against fungus, mosaic virus, stem wilt, damp-off, early blight, late blight and mold.

For use on corn, canola, soybeans, rice, sugar beets, vegetables, herbs, sunflowers, wheat, grains, cereals, legumes, and flowers.

ACTIVE INGREDIENT:	
Chitosan	0.25%
OTHER INGREDIENTS:	99.75%
Total	100.00%

Product contains 0.021 lb (0.01 kg) for chitosan/gallon

KEEP OUT OF REACH OF CHILDREN

CAUTION

SEE SIDE PANEL FOR PRECAUTIONARY STATEMENTS

MANUFACTURED FOR: Ag NuBio, Inc. 10300 Sunset Dr., Suite 179 Miami, FL 33173		**EPA Reg. No. 91664-3** **EPA Est. No. _____**	
Net Contents	**[ ] 1 oz**	**[ ] 12 oz**	**[ ] 2.5 gallons**

	[ ] 2.5 oz **[ ] 4 oz** **[ ] 8 oz** **[ ] 10 oz**	**[ ] 16 oz** **[ ] 500 ml** **[ ] 1 liter** **[ ] 1 gallon**	**[ ] 5 gallons** **[ ] 55 gallons** **[ ] 200 gallons** **[ ] 250 gallons**

FIRST AID	
If in eyes	• Hold eye open and rinse slowly and gently with water 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 treatment advice.
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 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 product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-800-222-1222 for emergency medical treatment information.	

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION: Causes moderate eye irritation. Avoid contact with eyes. Wash thoroughly with soap and water after handling.

ENVIRONMENTAL HAZARDS

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 cleaning equipment or disposing of equipment wash waters.

[For 5 gallon product: Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans, or public waters unless in accordance with the requirements of 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 into sewer without previously notifying the sewage treatment plant authority. For guidance, contact your State Water board or regional Office of the EPA.]

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Applicators, mixers, loaders and other handlers must wear: Long-sleeved shirt and long pants, waterproof gloves, protective eyewear, and shoes plus socks. Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables, use detergent and hot water. Keep and wash PPE separately from other laundry.

DIRECTIONS FOR USE

It is a violation of federal laws to use this product in a manner inconsistent with its labeling.

To prevent contamination of the dilute solutions of NuPro by possible pesticide or other chemical residues in the spraying equipment, use dedicated equipment, or be sure that the equipment is thoroughly clean before use.

For Agricultural Use:
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. For any requirements specific to your State or Tribe, consult the agency responsible for pesticide regulation.

Do not use treated seed for food or feed purposes or process for oil. Treat only those seeds needed for immediate use, minimizing the interval between treatment and planting.

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 interval. 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.

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
- Waterproof gloves
- Protective eyewear, and
- Shoes plus socks

GENERAL INSTRUCTIONS
Shake before using. Following specific crop instructions for dilution rates and application usage. Do not apply within three days of harvesting. For best results use pH neutral (pH 6.9 to 7.0) mix water.

Crops	**Mixing and Application Instructions**
Seed Treatment Beans (lima, snap, dry edible, cowpeas, peas), Broccoli, Brussels sprouts, Cabbage, Canola, Cantaloupe, Cauliflower, Corn (field, sweet and pop), Cotton, Cucumber, Eggplants, Flax, Grass grown for seed, Legumes (including alfalfa and clover), Onion, Ornamental flower crops, Peanuts, Safflower, Small grains (including wheat, oats, rye, barley, rice, millet, sorghum, triticale), Pumpkin, Soybeans, Squash, Sugar beet, Sunflowers, Tobacco, Tomato, Turfgrass, Watermelon	For seed treatment, Apply 0.1- 0.3 fluid ounces of product per 100 lbs. seed. Apply as a water based slurry through standard slurry or mist-type commercial seed treatment equipment. May be applied with other registered seed treatment products if compatibility is known.

Seed Piece Treatment	For Seed Piece Treatment
Potato Sweet potato	Mix 17 fluid ounces of product in 10 gallons of water. Dip tubers in mixture prior to planting. Plant tubers wet or allow to dry.
In-Furrow	Apply in-furrow at a rate of 0.85 fl. oz. per acre. [One 8.5 fl. oz. container will treat 10 acres in-furrow on 36" row spacing.]
Peanuts	

Storage and Disposal

Do not contaminate water, food, or feed by storage or disposal.

PESTICIDE STORAGE: Store in original container in a cool, dry place away from sunlight and out of the reach of children and pets. Do not reuse container.

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: Nonrefillable container. Do not reuse or refill this container. Offer for recycling, if available. Triple rinse or pressure rinse container (or equivalent) promptly after emptying. (For product less than 5 gallons) 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 1/4 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. (For product greater than 5 gallons) Triple rinse as follows: Empty the remaining contents into application equipment or a mix tank. Fill the container 1/4 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 more times. An empty container retains vapor and product residue. Observe label safeguards until container is cleaned, reconditioned or destroyed. Completely empty contents into formulation equipment. Then offer for recycling or reconditioning or, dispose of container in a manner approved by state and local authorities.

WARRANTY

Ag NuBio, Inc. warrants that this product conforms to the chemical description on the label thereof and is reasonably fit for purposes stated on such label only when used in accordance with directions under normal use conditions. It is impossible to eliminate all risks inherently associated with use of this product. Crop injury, ineffectiveness or other unintended consequences may result because of such factors as weather conditions, presence of other materials or the manner of use or application, all of which are beyond the control of **Ag NuBio, Inc.** To the extent consistent with applicable law, Ag NuBio, Inc. shall not be liable for consequential, special or indirect damages resulting from the use or handling of this product. All such risks shall be assumed by the Buyer. To the extent consistent with applicable law, the exclusive remedy of any buyer or user of this product for any and all losses, injuries, or damages resulting from or in any way arising from the use, handling, or application of this product, whether in contract, warranty, tort, negligence, strict liability, or otherwise, shall not exceed the purchase price paid for this product or at Ag NuBio, Inc. election, the replacement of this product. Ag NuBio, Inc. MAKES NO WARRANTIES OF

MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR ANY OTHER EXPRESS OR IMPLIED WARRANTY EXCEPT AS STATED ABOVE.

Manufactured For:
Ag NuBio, Inc.
10300 Sunset Dr., Suite 179
Miami, FL 33173
Batch Code:

Sublabel B: Ornamental and Nursery Uses

NuPro™

Ornamental, Field, and Nursery Use

[ABN: ODC Professional Foliar & Irrigation™, NuPro™ ST Seed Treatment, NuStar™, WinSar™]

NuPro™, NuSar™, and WinSar™ are trademarks of Ag Nubio

FOR ORGANIC PRODUCTION

When used as directed on this label, NuPro™ can boost seed germination and vitality, stimulate emergence and sprouting, enhance plant vigor, promote root growth, promote foliar growth, increase crop yields, improve crop vigor and quality, suppress diseases and pathogens, activate plant resistances to environment stress, drought, and disease pressures, including the suppression of plant parasitic nematodes.

Systemic Induced Resistance and Innate Immunity Protection
NuPro Protects pine trees against Pine Beetles, Mountain Pine Beetle and Bark Beetles.

NuPro protects field crops, ornamentals, trees, citrus, grasses, grains, legumes, fruits and vegetables against blue stain fungus, mosaic crop virus, stem wilt, damp-off, early blight, late blight and mold.

Protects ornamentals, fields, trees, grasses, grains, legumes, fruits, citrus, turf and sod, and vegetables.

For use on cotton, tobacco, banana, tropical plants, grasses, pine and deciduous trees, grains, legumes, fruits, vegetables, sugar beet, shrubs, ground covers, bedding plants, house plants, turf and sod and flowers.

ACTIVE INGREDIENT:	
Chitosan	0.25%
OTHER INGREDIENTS:	99.75%
Total	100.00%

Product contains 0.021 lb (0.01 kg) for chitosan/gallon

KEEP OUT OF REACH OF CHILDREN

CAUTION

SEE SIDE PANEL FOR PRECAUTIONARY STATEMENTS

MANUFACTURED FOR: Ag NuBio, Inc. 10300 Sunset Dr., Suite 179 Miami, FL 33173		**EPA Reg. No. 91664-3** **EPA Est. No. _____**	
Net Contents	**[ ] 1 oz** **[ ] 2.5 oz** **[ ] 4 oz**	**[ ] 12 oz** **[ ] 16 oz** **[ ] 500 ml**	**[ ] 2.5 gallons** **[ ] 5 gallons** **[ ] 55 gallons**

	[ ] 8 oz **[ ] 10 oz**	**[ ] 1 liter** **[ ] 1 gallon**	**[ ] 200 gallons** **[ ] 250 gallons**

FIRST AID	
If in eyes	• Hold eye open and rinse slowly and gently with water 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 treatment advice.
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 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 product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-800-222-1222 for emergency medical treatment information.	

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION: Causes moderate eye irritation. Avoid contact with eyes. Wash thoroughly with soap and water after handling.

ENVIRONMENTAL HAZARDS

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 cleaning equipment or disposing of equipment wash waters.

[For 5 gallon product: Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans, or public waters unless in accordance with the requirements of 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 into sewer without previously notifying the sewage treatment plant authority. For guidance, contact your State Water board or regional Office of the EPA.]

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Applicators, mixers, loaders and other handlers must wear: Long-sleeved shirt and long pants, waterproof gloves, protective eyewear, and shoes plus socks. Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables, use detergent and hot water. Keep and wash PPE separately from other laundry.

DIRECTIONS FOR USE

It is a violation of federal laws to use this product in a manner inconsistent with its labeling.

To prevent contamination of the dilute solutions of NuPro by possible pesticide or other chemical residues in the spraying equipment, use dedicated equipment, or be sure that the equipment is thoroughly clean before use.

Do not use treated seed for food or feed purposes or process for oil. Treat only those seeds needed for immediate use, minimizing the interval between treatment planting.

Non-Agricultural Use Requirements

The requirements in this box apply to uses of this product that are not within the scope of the Worker Protection Standard for agricultural pesticides (40 CFR Part 170). The WPS applies when this product is used to produce agricultural plants on farms, forests, nurseries or greenhouses. Keep people and pets of treated areas until spray solution has dried to prevent transfer of this product onto desirable vegetation.

GENERAL INSTRUCTIONS

Shake before using. For best results use pH neutral (pH 6.9 to 7.0) mix water. Follow specific crop instructions for dilution rates and application usage. Do not apply within three days of harvesting.

Crops	Mixing and Application Instructions
Seeds	• Mix 1 ml into 5 gallons or more • Apply enough product to wet the soil covering seeds. • Apply by spray, furrow and/or irrigation • Mix rate: 500 ml to 1500 ml into 10 to 50 gallons or more per acre
Minituber, seed potato, potato	• Mix rate: 500 ml into 10 to 50 gallons or more • Pre-dip tubers prior to planting • Apply enough product to wet tuber • Plant while tuber is wet or dry
Field crops including corn, soybean, wheat, alfalfa, small grains, grass, sugar beet, cotton, tobacco, and legume	• Mix rate: 500 ml into 50 to 500 gallons or more per acre • Apply before and after emergence; apply every 30 days as needed • Divide product into thirds to apply enough product at planting, after emergence, and mid-season • Apply by foliar spray, in furrow and/or irrigation
Vegetables and Herbs	• Mix rate: 500 ml into 50 to 500 gallons or more per acre • Apply before and after emergence; apply every 30 days as needed • Apply be foliar spray, in furrow and/or irrigation • Divide product into thirds apply at planting, after emergence, and mid-season • Application rate: 150 ml or more per acre
Nursery Crops- Trees & Shrubs	• Mix rate: 500 ml to 1500 ml into 50 to 500 gallons or more • Application rate: 500 ml to 1500 ml per acre • Apply every 30 to 45 days as needed • Apply by foliar spray and/or irrigation
Fruit Trees and Citrus	• Mix rate: 500 ml to 1500 ml into 50 to 500 gallons or more • Application rate: 500 ml to 1500 ml per acre • Apply every 30 days as needed

	• Apply by foliar spray, in furrow and/or irrigation
Turf and Sod	• Mix rate: 500 ml to 1500 ml into 500 gallons or more • Application rate: 500 ml to 1500 ml per acre • Apply area every 30 to 45 days as needed • Apply by irrigation or surface spray
Greenhouse & Horticultural Use-Ornamental Crops	• Mix rate: 1 ml to 100 ml product / 5 gallons or more • Apply area: 500 to 1000 sq ft; apply every two weeks as needed • Apply to soil and/or spray plants • May be applied by means of irrigation
Pellet	• Mix rate 1 ml to 30 ml product / gallon or more • Apply enough product to wet the moisture absorbing materials • Allow to dry or wet and spread evenly to soil or furrow • Apply every two weeks as needed
Transplanting	• Mix 1 ml into 5 gallons or more • Apply enough product to wet the soil covering transplant • Apply every two weeks as needed
Compost	• Mix rate: 500 ml to 1500 ml into gallon or more • Apply area: 1 acre; apply every two weeks as needed • May be applied by means of irrigation
Field Applications	• Mix rate: 500 ml to 1500 ml into 50 to 500 gallons or more • Apply at planting time and after emergence; apply every 30 days as needed • Application rate: 500 ml to 1500 ml per acre • Apply by foliar spray, in furrow or irrigation

Storage and Disposal

Do not contaminate water, food, or feed by storage or disposal.

PESTICIDE STORAGE: Store in original container in a cool, dry place away from sunlight and out of the reach of children and pets. Do not reuse container.

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: Nonrefillable container. Do not reuse or refill this container. Offer for recycling, if available. Triple rinse or pressure rinse container (or equivalent) promptly after emptying. (For product less than 5 gallons) 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 1/4 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. (For product greater than 5 gallons) Triple rinse as follows: Empty the remaining contents into application equipment or a mix tank. Fill the container 1/4 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

more times. An empty container retains vapor and product residue. Observe label safeguards until container is cleaned, reconditioned or destroyed. Completely empty contents into formulation equipment. Then offer for recycling or reconditioning or, dispose of container in a manner approved by state and local authorities.

WARRANTY

Ag NuBio, Inc. warrants that this product conforms to the chemical description on the label thereof and is reasonably fit for purposes stated on such label only when used in accordance with directions under normal use conditions. It is impossible to eliminate all risks inherently associated with use of this product. Crop injury, ineffectiveness or other unintended consequences may result because of such factors as weather conditions, presence of other materials or the manner of use or application, all of which are beyond the control of **Ag NuBio, Inc.** To the extent consistent with applicable law, Ag NuBio, Inc. shall not be liable for consequential, special or indirect damages resulting from the use or handling of this product. All such risks shall be assumed by the Buyer. To the extent consistent with applicable law, the exclusive remedy of any buyer or user of this product for any and all losses, injuries, or damages resulting from or in any way arising from the use, handling, or application of this product, whether in contract, warranty, tort, negligence, strict liability, or otherwise, shall not exceed the purchase price paid for this product or at Ag NuBio, Inc. election, the replacement of this product. Ag NuBio, Inc. MAKES NO WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR ANY OTHER EXPRESS OR IMPLIED WARRANTY EXCEPT AS STATED ABOVE.

Manufactured For:
Ag NuBio, Inc.
10300 Sunset Dr., Suite 179
Miami, FL 33173

Batch Code:

Sublabel C: Home & Garden Use

NuPro™

Home & Garden Use

[ABN: ODC Home & Garden™, NuPro™ ST Seed Treatment, NuStar™, WinSar™]

NuPro™, NuSar™, and WinSar™ are trademarks of Ag Nubio

When used as directed on this label, NuPro™ can boost seed germination and vitality, stimulate emergence and sprouting, enhance plant vigor, promote root growth, promote foliar growth, increase crop yields, improve crop vigor and quality, suppress diseases and pathogens, activate plant resistances to environment stress, drought, and disease pressures, including the suppression of plant parasitic nematodes.

Systemic Induced Resistance and Innate Immunity Protection
NuPro Protects pine trees against Pine Beetles, Mountain Pine Beetle and Bark Beetles.

NuPro protects field crops, ornamentals, trees, citrus, grasses, grains, legumes, fruits and vegetables against blue stain fungus, mosaic crop virus, stem wilt, damp-off, early blight, late blight and mold.

Protects ornamentals, fields, trees, grasses, grains, legumes, fruits, citrus, turf and sod, and vegetables.

For use on tropical plants, grasses, pine and deciduous trees, shrubs, ground covers, bedding plants, house plants, herbs, vegetables, fruits, citrus, turf and sod and flowers.

ACTIVE INGREDIENT:	
Chitosan	0.25%
OTHER INGREDIENTS:	99.75%
Total	100.00%

Product contains 0.021 lb (0.01 kg) for chitosan/gallon

KEEP OUT OF REACH OF CHILDREN

CAUTION

SEE SIDE PANEL FOR PRECAUTIONARY STATEMENTS

MANUFACTURED FOR: Ag NuBio, Inc. 10300 Sunset Dr., Suite 179 Miami, FL 33173		**EPA Reg. No. 91664-3** **EPA Est. No. _____**	
Net Contents	**[ ] 1 oz** **[ ] 2.5 oz** **[ ] 4 oz** **[ ] 8 oz** **[ ] 10 oz**	**[ ] 12 oz** **[ ] 16 oz** **[ ] 500 ml** **[ ] 1 liter** **[ ] 1 gallon**	**[ ] 2.5 gallons** **[ ] 5 gallons** **[ ] 55 gallons** **[ ] 200 gallons** **[ ] 250 gallons**

FIRST AID	
If in eyes	• Hold eye open and rinse slowly and gently with water 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 treatment advice.
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 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 product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-800-222-1222 for emergency medical treatment information.	

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION: Causes moderate eye irritation. Avoid contact with eyes. Wash thoroughly with soap and water after handling.

ENVIRONMENTAL HAZARDS

To protect the environment, do not allow pesticide to enter or run off into storm drains, drainage ditches, gutters or surface waters. Applying this product in calm weather when rain is not predicted for the next 24 hours will help to ensure that wind or rain does not blow or wash pesticide off the treated area. Rinsing application equipment over treated area will help avoid run off to water bodies or drainage systems.

DIRECTIONS FOR USE

It is a violation of federal laws to use this product in a manner inconsistent with its labeling.

To prevent contamination of the dilute solution of NuPro by possible pesticide or other chemical residues in the spraying equipment, use dedicated equipment, or be sure that the equipment is thoroughly clean before use.

Do not use treated seed for food or feed purposes or process for oil. Treat only those seeds needed for immediate use, minimizing the interval between treatment planting.

GENERAL INSTRUCTIONS

Shake before using. For best results use pH neutral (pH 6.9 to 7.0) mix water. Follow specific crop instructions for dilution rates and application usage. Do not apply within three days of harvest.

Crops	Mixing and Application Instructions
Seeds	• Mix 1 ml to 5 ml into 5 gallons • Apply enough product to wet the soil covering seeds. • Apply every week as needed

Home & Garden – Bedding Plants, Vegetables, Flowers and Ornamentals	• Mix rate: 1 ml to 5 ml product into 5 gallons or more • Application area: 1000 sq ft or more • Apply to soil and/or spray plants, apply additional water to soil as needed • May be applied by means of irrigation or sprayer • Apply every two weeks as needed
Compost	• Mix rate: 1 ml to 5 ml into 5 gallons or more • Application area: 10 to 100 sq ft • May be applied by means of irrigation or sprayer • Apply every two weeks as needed
Turf and Sod	• Mix rate: 1 ml to 5 ml product into 5 gallons or more • Application area: 1000 sq ft or more • Water area and spray surface area • May be applied by means of irrigation or sprayer • Apply every 10 days as needed
Trees, shrubs	• Mix rate: 1 ml to 5 ml product into 5 to 10 gallon • May be applied by means of sprayer, apply additional water to soil as needed • Apply every 30 to 45 days as needed to soil under the drip line

Storage and Disposal

Do not contaminate water, food, or feed by storage or disposal.

PESTICIDE STORAGE: Store in original container in a cool, dry place away from sunlight and out of the reach of children and pets. Do not reuse container.

PESTICIDE DISPOSAL AND CONTAINER HANDLING: Non-refillable container. **If empty**: Do not reuse or refill this container. Place in trash or offer for recycling if available. **If partly filled:** Call your local solid waste agency or 1-800-CLEANUP for disposal instructions. Never place unused product down any indoor or outdoor drain.

WARRANTY

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Manufactured For:
Ag NuBio, Inc.
10300 Sunset Dr., Suite 179
Miami, FL 33173

Batch Code:

Optional Marketing Claims:

- Elicitor
- Elicitation of plant enzymes for plant vitality
- For Use Throughout the Growing Season
- Easy to Use
- Increases Yields
- Boost Your Production
- Enhance blooms and yields
- Promote Healthier Plants
- Healthier plants resist disease and pathogen attaches
- Improve plant vigor
- Fortifies plant defense mechanisms
- Elicit better crop performance
- Larger Flowers
- Robust Plant Growth Leads to Early Harvest
- Robust Plant Growth Leads to [Increase Yields][Larger Fruit][Larger Vegetables]
- Higher Pack-out equals more return per acre
- More large fruit
- Delays senescence
- Reduce bruising and blemishes
- Longer shelf life for crops
- Reduces ethylene production
- Elevate sugar content
- Overcomes environmental stress
- Healthier plants defend themselves better against nibblers
- Increases germination rates and seed vitality
- Improve sprouting
- Stronger emergence
- Increases bio-mass
- Better Stand Quality
- Induced Systemic Resistance against pathogens and disease
- Elevate innate immunity defense mechanisms in plants
- Elevate defense mechanisms in plants
- Activate chemical engines within plants
- Boost Plant Health
- Amendment for better crop performance
- Healthier Stand

- Proprietary Elicitor
- Crop and Yield Promoter
- Broad spectrum Biopesticide
- Allows plants to defend for themselves against pathogen, disease and pests
- Fast acting formula
- Guaranteed not to be harmful to crops
- Chitosan is one of the most common compounds in nature
- Boosts the ability of plants to defend against fungal infections
- [Product Name] provides protection against downy mildew, powdery mildew, early blight, late blight, gray mold, leaf spot, anthracnose, Stem wilt, damp-off, stem blight, stem cankering, and seed piece decay
- [Product Name] Able to bolster plant resistance against fungal diseases.
- Spray to plants throughout the growing season
- Mix and water plants throughout the growing season
- Indoor and outdoor use!
- [Product Name] Provides long lasting protection and innate immunity
- [Product Name} Provides long lasting systemic protection against disease, pathogens and pests
- More vigorous plants
- Results in healthier, more vigorous plants and increased yield
- [Product Name] Enhancement of soil microflora and beneficial microbes
- [Product Name] Shortens the time required for expression of mature plant resistance
- Fast results; mature plant resistance
- Stimulates growth
- Triggers the defensive mechanisms in plants for better production
- Use for bloom and fruit setting stimulation
- Protecting coating for fruits and vegetables
- Enhanced front protection
- [Product Name] SIR in sunflower which increases antioxidant activity and vitamin C levels in plants
- Extends the shelf life of treated fruit and vegetables
- Increased resin-based defense capability
- Increased Harvest yields
- Help Trees protect against pine beetles and blue stem mold
- Love your trees – stop pine beetles
- ODC Induced systemic resistance increases oleoresin flow and resinous lesion formulation
- Pre-arm trees while they have a fighting chance
- Proven effective to boost plant resistance
- Proven effective to elicit defense responses in pine trees
- Proven effective to elicit defense responses in pine trees against pine beetles and blue stain fungus
- Increases pine resin pitch-out to stop pine beetles
- Protects plants from harmful nematodes
- Protects plants and beneficial nematodes
- ODC stop the pine beetle
- Activates Innate Immunity
- ODC increases pine resin pitch-out when applied to the soil and/or needles, induces blue stain mold control for Integrated Pest Management (IPM) programs

- [Product Name] has been shown effective to activate immune-like systems in plants against environmental stress, pests, disease and drought
- There have been over 20 years of ODC defense response tests on many plants including trees, shrubs, grasses and flowers.
- Cost effective colloidal chitosan solution made from shellfish
- ODC Tree Protection Solution
- Inexpensive alternative to costly pesticides
- [Product Name] SIR & Innate Immunity Image

Some pests and diseases control by NuPro™

Crop Name	**Name of disease, pathogen, pest**
Apple	*Penicillium expansum*
Apple	*Botrytis cinerea* and *Penicillium expansum*
Barley	*Fusarium culmorum*
Carrot	*Sclerotinia sclerotiorum*
Celery	*Fusarium oxysporum*
Citrus	*Penicillium digitatum*
Conifers	*Ophiostoma minus*
Grand fir	Bark Beetle
Grapes	Gray mold
Grasses	Gray mold
Loblolly Pine	*Ophiostoma clavigerum*
Lodgepole Pine	*Ophiostoma minus*
Lodgepole Pine	*Ceratocystis clavigera*
Norway spruce	*Ceratocystis polonica* (the bark beetle-associated blue stain fungus)
Oranges Lemons	*Botrytis cinerea* and *Penicillium expansum*
Peach	*Botrytis cinerea*
Peanuts	*Penicillium*
Peas	*Nectria haematocca*
Peas	*Dendroctonus ponderosae* (Mountain pine beetle [MPB]) associated
Pine	Blue stain fungus
Pinus Nigra	*Sphaeropsis sapient* and *Diplodia scrobiculata*
Potato	*Penicillium*
Potato	*Verticillium*
Potato	*Rhizoctonia*
Potato	*Erwinia*

Potato	Nematode
Potato	Late Blight
Slash Pine	*Fusarium subglutinans, F. sp., Pini*
Soybeans	Cyst Nematode
Soybeans	White Mold
Strawberry	*Phytophthora cactorum*
Tomato	Cucumber mosaic virus
Tomato	*Fusarium oxysporum, F. sp.*
Tomato	*Cladosporium fulvum*
Tomato	Nematode
Western Pines	*Ophiostoma minus*
Wheat	*F. culmorum*

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Pesticide Programs
Registration Division (7505T)
1200 Pennsylvania Ave., N.W.
Washington, D.C. 20460

NOTICE OF PESTICIDE:
_X_ Registration
___ Reregistration
(under FIFRA, as amended)

EPA Reg. Number:	**Date of Issuance:**
91664-4	3/7/24

Term of Issuance:
Unconditional

Name of Pesticide Product:
Biorend Cu

Name and Address of Registrant (include ZIP Code):

Eric Bosarge, Agent for AgNubio, Inc.
c/o SmithBosarge LLC
2323 Clear Lake City Blvd. #194
Houston, TX 77062

Note: Changes in labeling differing in substance from that accepted in connection with this registration must be submitted to and accepted by the Registration Division prior to use of the label in commerce. In any correspondence on this product always refer to the above EPA registration number.

On the basis of information furnished by the registrant, the above named pesticide is hereby registered under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA).

Registration is in no way to be construed as an endorsement or recommendation of this product by the Agency. In order to protect health and the environment, the Administrator, on his motion, may at any time suspend or cancel the registration of a pesticide in accordance with the Act. The acceptance of any name in connection with the registration of a product under this Act is not to be construed as giving the registrant a right to exclusive use of the name or to its use if it has been covered by others.

This product is unconditionally registered in accordance with FIFRA section 3(c)(5) provided that you:

1. Submit and/or cite all data required for registration/reregistration/registration review of your product when the Agency requires all registrants of similar products to submit such data.

2. The data requirements for storage stability and corrosion characteristics (Guidelines 830.6317 and 830.6320) are not satisfied. You have 18 months from the date of registration to provide these data.

Continues page 2

Signature of Approving Official:

Kristy Crews

Kristy Crews, Ph.D., Product Manager 22
Fungicide Branch, Registration Division (7505T)
Office of Pesticide Programs, USEPA

Date:
3/7/24

EPA Form 8570-6

3. Make the following label changes before you release the product for shipment:

    - Revise the EPA Registration Number to read, “EPA Reg. No. 91664-4.”

4. Submit one copy of the final printed label for the record before you release the product for shipment.

Should you wish to add/retain a reference to the company’s website on your label, then please be aware that the website becomes labeling under FIFRA and is subject to review by the Agency. If the website is false or misleading, the product would be misbranded and unlawful to sell or distribute under FIFRA section 12(a)(1)(E). 40 CFR 156.10(a)(5) lists examples of statements EPA may consider false or misleading. In addition, regardless of whether a website is referenced on your product’s label, claims made on the website may not substantially differ from those claims approved through the registration process. Therefore, should the Agency find or if it is brought to our attention that a website contains false or misleading statements or claims substantially differing from the EPA approved registration, the website will be referred to the EPA’s Office of Enforcement and Compliance.

If these conditions are not complied with, the registration will be subject to cancellation in accordance with FIFRA section 6. Your release for shipment of the product constitutes acceptance of these conditions. A stamped copy of the label is enclosed for your records.

The record for this product currently contains the following CSF:

- Basic CSF dated 06/01/2019

If you have any questions, please contact Kristy Crews by phone at (202) 566-1813, or via email at Crews.Kristy@epa.gov; or Craig Reeves by phone at (202) 566-2869, or via email at Reeves.Craig@epa.gov.

Enclosure- Stamped Label

MASTER LABEL: All text present before the start of the first sub-label will be present on all labels.

COPPER	GROUP	M1	FUNGICIDE

[*Note to Reviewer*: Resistance management box will only appear on agricultural use sub-labels.]

BIOREND® Cu

Bactericide, Fungicide & Plant Defense Booster

BIOREND® is a registered trademark of BioAgro, SA

ACTIVE INGREDIENTS:

Chitosan *	1.34%
Copper Sulfate Pentahydrate*	23.46%
OTHER INGREDIENTS:	75.20%
Total	100.00%

*Contains 0.14 lbs. of chitosan and 0.617 lbs. metallic copper per gallon of product.

KEEP OUT OF REACH OF CHILDREN

DANGER/PELIGRO

Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detalle.
(If you do not understand the label, find someone to explain it to you in detail.)

FIRST AID	
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. • Call a poison control center or doctor for treatment advice.
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 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 by a poison control center or doctor. • Do not give anything by mouth 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, doctor, or going for treatment. For emergency medical treatment information, call the National Poison Control Center 24-hours a day at 1-800-222-1222.	
NOTE TO PHYSICIAN: Probable mucosal damage may contraindicate the use of gastric lavage.	

[*Optional Text:* See side/inside/back panel for additional precautionary statements, handling, Directions for Use and Storage and Disposal.]

Manufactured for:
Ag NuBio, Inc.
10300 Sunset Drive, Suite 179
Miami, FL 33173

ACCEPTED
03/07/2024
Under the Federal Insecticide, Fungicide and Rodenticide Act as amended, for the pesticide registered under EPA Reg. No. 91664-4

EPA Reg. No. 91664-U
EPA Est. No. _____
Net Contents: _____

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

DANGER/PELIGRO: Corrosive. Causes irreversible eye damage. Do not get in eyes or on clothing. Wear protective eyewear such as goggles, face shield, or safety glasses. Harmful if swallowed, absorbed through skin or inhaled. Avoid contact with skin, eyes or clothing. Avoid breathing vapor or spray mist. Remove and wash contaminated clothing before reuse.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Applicators, mixers, loaders and other handlers must wear:

- protective eyewear such as goggles, face shield, or safety glasses,
- long-sleeved shirt,
- long pants,
- chemical resistant gloves made of any waterproof material such as polyvinyl chloride ≥ 14 mils, nitrile rubber ≥ 14 mils or butyl rubber ≥ 14 mils, and
- shoes plus socks.

Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables, use detergent and hot water. Keep and wash PPE separately from other laundry.

Discard clothing and other absorbent material that have been drenched or heavily contaminated with the product's concentrate. Do not reuse them.

Engineering Controls Statement:
Pilots must use an enclosed cab that meets the definition listed in the WPS for agricultural pesticides [40 CFR 170.305].

USER SAFETY RECOMMENDATIONS

Users should:

- Wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet. Remove and wash contaminated clothing before reuse.
- Remove clothing/PPE immediately if pesticide gets 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

This product is toxic to fish and aquatic invertebrates and may contaminate water through runoff. This product has a potential for runoff for several months or more after application. Poorly draining soils and soils with shallow water tables are more prone to produce runoff that contains this product. Drift and runoff may be hazardous to aquatic organisms in water adjacent to treated areas. 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 cleaning equipment or disposing of equipment wash waters or rinsate. Do not allow runoff into lakes, streams, ponds or public waterways.

PHYSICAL AND CHEMICAL HAZARDS

Do not mix or allow product to come in contact with oxidizing agents. Hazardous chemical reaction may occur.

SUB-LABEL A: Agricultural Uses

DIRECTIONS FOR USE

It is a violation of federal law to use this product in a manner inconsistent with its labeling. 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. For any requirements specific to your state or tribe, consult the agency responsible for pesticide regulation. READ THE ENTIRE LABEL BEFORE USING THIS PRODUCT.

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 interval. The requirements in this box only apply to uses of this product that are covered by the Worker Protection Standard.

Engineering Controls Statement:

Pilots must use an enclosed cab that meets the definition listed in the WPS for agricultural pesticides [40 CFR 170.305].

Do not enter or allow worker entry into treated areas during the restricted entry interval (REI) of 48 hours.

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
- Protective eyewear such as goggles, face shield, or safety glasses
- Chemical-resistant gloves made of any water-proof material such as polyvinyl chloride ≥ 14 mils, nitrile rubber ≥ 14 mils or butyl rubber ≥ 14 mils, and
- Shoes plus socks

Do not enter or allow others to enter until sprays have dried.

NON-AGRICULTURAL USE REQUIREMENTS

The requirements in this box apply to uses of this product that are NOT within the scope of the Worker Protection Standard for agricultural pesticides (40 CFR Part 170). The WPS applies when this product is used to produce agricultural plants on farms, forests, nurseries, and greenhouses.

Keep children, pets and other unprotected persons out of treated area until sprays have dried.

PRODUCT INFORMATION

BIOREND® Cu is a combination fungicide, bactericide and plant defense booster. Complete coverage is essential to assure good product performance.

The chitosan, also known as poly-D-glucosamine, in BIOREND® Cu stimulates SAR (Systemic Acquired Resistance) mechanism, which allows plants to be less susceptible to bacterial and fungal diseases. BIOREND® Cu also supports the healing of wounds, to reduce the incidence of fungal and bacterial diseases.

When used as directed on this label BIOREND® Cu can enhance plant vigor, promote foliar growth, increase crop yields, improve crop vigor and quality, aid in suppression of diseases and pathogens, activate plant resistance to environmental stress, drought and disease pressure.

RESISTANCE MANAGEMENT

BIOREND® Cu contains a Group M1 fungicide. Fungal isolates/bacterial strains with acquired resistance to GroupM1 may eventually dominate the fungal/bacterial population if Group M1 fungicides/bactericides are used repeatedly in the same field or in successive years as the primary method of control for targeted species. This may result in partial or total loss of control of those species by BIOREND® Cu or other Group M1 fungicides.

For resistance management, BIOREND® Cu contains a Group M1 fungicide. Any fungal population may contain individuals naturally resistant to BIOREND® Cu and other Group M1 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 BIOREND® Cu or other Group M1 fungicides with other mode of actions fungicides within a growing season sequence with different groups that control the same pathogens.
- Use tank mixtures or premixes with fungicides 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, certified crop advisors and/or manufacturer for fungicide/bactericide resistance management and/or integrated management recommendations for specific crops and resistant biotypes.
- For further information or to report suspected resistance, contact your local pesticide distributor or Ag Nubio, Inc. at contactus@agnubioinc.com. You can also contact your university extension specialist to report resistance.

MANDATORY SPRAY DRIFT

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Aerial Applications:

- Do not release spray at a height greater than 10 feet above the vegetative canopy or water, unless a greater application height is necessary for pilot safety.
- Applicators are required to use a medium or coarser droplet size (ASABE S572.1).
- Applicators must use ½ swath displacement upwind at the downwind edge of the field.
- Do not apply when wind speeds exceed 15 miles per hour at the application site. If the windspeed is greater than 10 mph, the boom length must be 65% or less of the wingspan for fixed wing aircraft and 75% or less of the rotor diameter for helicopters. Otherwise, the boom length must be 75% or less of the wingspan for fixed-wing aircraft and 90% or less of the rotor diameter for helicopters.
- Do not apply during temperature inversions.

Ground Applications:

- Apply with the nozzle height recommended by the manufacturer, but no more than 3 feet above the ground or crop canopy.
- For all applications, applicators are required to use a medium or coarser droplet size (ASABE S572.1).
- Do not apply when wind speeds exceed 10 miles per hour at the application site.
- Do not apply during temperature inversions.

Boom-less Ground Applications:

- Applicators are required to use a medium or coarser droplet size (ASABE S572.1) for all applications.
- Do not apply when wind speeds exceed 10 miles per hour at the application site.
- Do not apply during temperature inversions.

SPRAY DRIFT ADVISORIES

THE APPLICATOR IS RESPONSIBLE FOR AVOIDING OFF-SITE SPRAY DRIFT. BE AWARE OF NEARBY NON-TARGET SITES AND ENVIRONMENTAL CONDITIONS.

IMPORTANCE OF DROPLET SIZE

An effective way to reduce spray drift is to apply large droplets. Use the largest droplets that provide target pest control. While applying larger droplets will reduce spray drift, the potential for drift will be greater if applications are made improperly or under unfavorable environmental conditions.

Controlling Droplet Size – Ground Boom

- Volume - Increasing the spray volume so that larger droplets are produced will reduce spray drift. Use the highest practical spray volume for the application. If a greater spray volume is needed, consider using a nozzle with a higher flow rate.
- Pressure - Use the lowest spray pressure recommended for the nozzle to produce the target spray volume and droplet size.
- Spray Nozzle - Use a spray nozzle that is designed for the intended application. Consider using nozzles designed to reduce drift.

Controlling Droplet Size – Aircraft

- Adjust Nozzles - Follow nozzle manufacturers recommendations for setting up nozzles. Generally, to reduce fine droplets, nozzles should be oriented parallel with the airflow in flight.

BOOM HEIGHT – Ground Boom

Use the lowest boom height that is compatible with the spray nozzles that will provide uniform coverage. For ground equipment, the boom should remain level with the crop and have minimal bounce.

RELEASE HEIGHT - Aircraft

Higher release heights increase the potential for spray drift. When applying aerially to crops, do not release spray at a height greater than 10 ft. above the crop canopy, unless a greater application height is necessary for pilot safety.

SHIELDED SPRAYERS

Shielding the boom or individual nozzles can reduce spray drift. Consider using shielded sprayers. Verify that the shields are not interfering with the uniform deposition of the spray on the target area.

TEMPERATURE AND HUMIDITY

When making applications in hot and dry conditions, use larger droplets to reduce effects of evaporation.

TEMPERATURE INVERSIONS

Drift potential is high during a temperature inversion. Temperature inversions are characterized by increasing temperature with altitude and are common on nights with limited cloud cover and light to no wind. The presence of an inversion can be indicated by ground fog or by the movement of smoke from a ground source or an aircraft smoke generator. Smoke that layers and moves laterally in a concentrated cloud (under low wind conditions)

indicates an inversion, while smoke that moves upward and rapidly dissipates indicates good vertical air mixing. Avoid applications during temperature inversions.

WIND
Drift potential generally increases with wind speed. AVOID APPLICATIONS DURING GUSTY WIND CONDITIONS.

Applicators need to be familiar with local wind patterns and terrain that could affect spray drift.

Boom-less Ground Applications:
Setting nozzles at the lowest effective height will help to reduce the potential for spray drift.

Handheld Technology Applications:
Take precautions to minimize spray drift.

PLANT SAFETY

As plant varieties of stone fruit, pome fruit, grapes and cucurbits differ in sensitivity to copper, always evaluate injury potential to BIOREND® Cu prior to treating orchards or fields.

CHEMIGATION INSTRUCTIONS

Apply this product only through overhead sprinkler, including center pivot, lateral move, end tow, side (wheel) roll, big gun, solid set, or hand move; drip (trickle); or flood (basin) irrigation system(s). Do not apply this product through any other type of irrigation equipment. Crop injury, lack of effectiveness, or illegal pesticide residues in the crop 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.

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 backflow.
- The pesticide injection pipeline must contain a function, 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, inter-locking 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.
- Use a pesticide supply tank for the mixing and application of BIOREND® Cu in chemigation systems.
- Remove scale, pesticide residues, and other foreign matter from the chemical tank and entire injector system. Flush with clean water.

MIXING AND APPLICATION INSTRUCTIONS

Preparation of sprays: Fill the application container up to 1/3 of its capacity. Add BIOREND® Cu according to the recommended dose with the agitation system on and make up to volume with water. To improve solution of water and BIOREND® Cu, use water of pH 5.5 to 6.5. If pH of the water is over 6.5, use a buffer to reduce pH to be within the mentioned range.

Compatibility: To determine the physical compatibility of BIOREND® Cu with any other product, use a small container to mix a small amount (e.g. 1 pint) of spray solution, containing all ingredients in the same order and ratio as the anticipated use. If any indication of physical incompatibility develops, do not use this mixture for spraying. Indications of incompatibility usually appear within 5-15 minutes after mixing. Read and follow all directions and precautions on this label and on the other labels of any products for which a tank mixture is being considered. To improve compatibility, use water of pH 5.5 to 6.5. If pH of the water is over 6.5, use a buffer to reduce pH to be within the mentioned range. When mixing with other products, add the other product(s) to the buffered water (pH 5.5 to 6.5) and add the BIOREND® Cu to the mixture last.

Cleaning Application Equipment

To prevent contamination of the dilute solution of BIOREND® Cu by possible pesticides or other chemical residues in the spraying equipment, make sure that the equipment is thoroughly clean before and after use.

The following table shows suggested minimum spray volumes per acre; however, thorough coverage is essential for best results. The stage of growth and size are major factors in determining spray volume required to obtain thorough coverage. For questions regarding spray volumes needed, consult the local cooperative extension service for spray volume applicable to your particular crop.

Spray Volume (Gallons Per Acre) When Applying BIOREND® Cu	
	Ground Application
Field Crops	20
Citrus	50
Small Fruits	50
Tree Crops	100
Vegetables	20
Vines	50
Miscellaneous	50

USE RESTRICTIONS

- DO NOT spray this product if rain is coming soon. Reapplication may be necessary if rain after application is heavy.
- DO NOT apply if wind is high.
- DO NOT use carbon steel tanks for mixing; use plastic, bronze or stainless steel tanks.
- For applications made to watercress, production fields must be drained of water at least 24 hours prior to each application and water must not be reapplied to the field for a minimum of 24 hours following each application. Copper must not be applied to watercress during the aquatic production phase.
- Do not apply more than 9.72 gallons of BIOREND® CU (6 lbs. copper) per acre per year to Apples, Pears and Strawberries.
- Do not apply more than 10.21 gallons of BIOREND® CU (6.3 lbs. copper) per acre per year to Pecans.

USE PRECAUTIONS

BIOREND® Cu may be reactive on metal surfaces such as galvanized roofing. Avoid contact with cars, houses or other metal surfaces susceptible to damage. BIOREND® Cu may discolor sprayed surfaces such as masonry or wood.

Except as specified, begin applications before or at first sign of disease and repeat as needed to maintain control but observe use limitations. Maximum application is for a crop cycle. Crop cycle is defined as pre-bloom through post-harvest. Apply the high rate and/or spray at shorter intervals when climatic conditions favor disease(s). Apply the low rate and/or spray at larger intervals when climatic conditions least favor disease(s). If you are unaware of the climatic conditions favorable for disease(s) claimed for the specific use sites, you must consult your State Agricultural Extension Service to learn of these conditions.

FIELD CROPS

Crop	Disease	Use Rate in Pints Per Acre	Maximum Annual Rate in Pints per Acre	Application Instructions
Alfalfa	Cercospora Leaf Spot, Leptosphaerulina Leaf Spot	0.4 – 0.9 (0.007 – 0.016 lbs. chitosan and 0.03 – 0.07 lbs. copper)	3.5 (0.061 lbs. chitosan and 0.27 lbs. copper)	Apply 10-14 days before each harvest or earlier if disease threatens. **NOTE:** Spray injury may occur with sensitive varieties such as Lahontan. Minimum retreatment interval is 30 days.
Corn (Field Corn, Popcorn, Sweet Corn)	Bacterial Stalk Rot	0.4 – 1.3 (0.007 – 0.023 lbs. chitosan and 0.03 – 0.1 lbs. copper)	5.3 (0.093 lbs. chitosan and 0.41 lbs. copper)	Begin treatment when disease first appears and every 7 to 10 days or as needed. Use the higher rates and shorter spray intervals when conditions favor disease. Minimum retreatment interval is 7 days.
Peanut	Cercospora Leaf Spot	0.7 – 1.1 (0.012 – 0.019 lbs. chitosan and 0.05 – 0.08 lbs. copper)	7.7 (0.135 lbs. chitosan and 0.59 lbs. copper)	Begin spraying at 35 to 40 days after planting or when disease symptoms first appear and repeat at 10 to 14 day intervals or as needed. Reduce sprays to 7 day intervals during humid weather. Use the higher rates when conditions favor disease. Flowable sulfur may be added. Minimum retreatment interval is 7 days.
Potato	Early Blight, Late Blight	0.4 – 1.3 (0.007 – 0.023 lbs. chitosan and 0.03 – 0.1 lbs. copper)	19.3 (0.38 lbs. chitosan and 1.49 lbs. copper)	Apply 0.4 – 1.3 pints at 7 to 10 day intervals or as needed starting when plants are 2 to 6 inches high in locations where disease is light. Apply up to 1.35 pints per acre when disease is more severe. Under conditions of severe disease, control with BIOREND® Cu will be improved by tank mixing with other compatible fungicides registered for use on potatoes. Read and follow all label instructions of tank mix partners. Minimum retreatment interval is 5 days.
Sugar Beet	Cercospora Leaf Spot	0.4 – 1.3 (0.007 – 0.023 lbs. chitosan and 0.03 – 0.1 lbs. copper)	6.66 (0.116 lbs. chitosan and 0.51 lbs. copper)	Begin application when conditions favor disease development and repeat at 10 to 14 day intervals or as needed. Use the higher rates when conditions favor disease. Addition of as spreader/sticker is recommended. Minimum retreatment interval is 10 days.
Wheat, Barley, Oats	Helminthosporium Spot, Blotch, Septoria Leaf Blotch	0.4 – 1.3 (0.007 – 0.023 lbs. chitosan and 0.03 – 0.1 lbs. copper)	1.3 (0.023 lbs. chitosan and 0.10 lbs. copper)	Make first application at early heading and follow with second spray 10 days later. Use the higher rates when conditions favor disease. For wheat, BIOREND® Cu can be applied as a foliar application for early season disease control and again at early heading and followed with another application 10 days later. Minimum retreatment interval is 10 days.

CITRUS

Crop	Disease	Use Rate in Pints Per Acre	Maximum Annual Rate in Pints per Acre	Application Instructions
Citrus (Grapefruit, Kumquat, Lemon, Lime, Oranges, Pummelo, Tangelo, Tangerine)	Citrus Canker (Suppression)	0.9 – 2.6 (0.016 – 0.046 lbs. chitosan and 0.07 – 0.2 lbs. copper)	44.8 (0.784 lbs. chitosan and 3.45 lbs. copper)	Spray flushes 7 to 14 days after shoots begin to grow. Young fruit may require an additional application. Number and timing of applications will be dependent upon disease pressure. Under heavy pressure, each flush of new growth should be sprayed. Minimum retreatment interval is 7 days,
	Algal Spot, Melanose, Scab	1.3 – 4.4 (0.023 – 0.077 lbs. chitosan and 0.10 – 0.34 lbs. copper)		Apply as pre-bloom and post bloom sprays Use higher rates when conditions favor disease. Minimum retreatment interval is 14 days.
	Alternaria Brown Rot	1.3 – 3.1 (0.023 – 0.054 lbs. chitosan and 0.10 – 0.24 lbs. copper)		On susceptible varieties apply when the first spring flush appears and each following flush. Application to fruit should start after2/3 of the petals have fallen and be repeated on a 21 day schedule or as needed. Use the higher rates when conditions favor disease. Minimum retreatment interval is 14 days.
	Greasy Spot, Pink Pitting	0.4 – 2.2 (0.007 – 0.039 lbs. chitosan and 0.03 – 0.17 lbs. copper)		Apply in summer on expanded new flush. Repeat on subsequent flushes where disease pressure is severe. Use the higher rates when conditions favor disease. Minimum retreatment interval is 14 days.
	Phytophthora Brown Rot, Septoria Spot	1.3 – 3.1 (0.023 – 0.054 lbs. chitosan and 0.10 – 0.24 lbs. copper)		Begin application in fall before or just after the first rain and continue as needed. For Brown Rot only apply to skirts of trees to a height of at least 4 feet. For control of Septoria Sport or where fruit have already been infected with Brown Rot, apply to entire tree. Apply to bare ground one foot beyond skirt. Use the higher rates when conditions favor disease. Do not use in areas subject to copper injury. Minimum retreatment interval is 7 days.

SMALL FRUITS

Crop	Disease	Use Rate in Pints Per Acre	Maximum Annual Rate in Pints per Acre	Application Instructions
Blackberry (Aurora, Boysen, Cascade, Chehalem, Logan, Marion, Santiam, Thornless Evergreen)	Anthracnose, Cane Spot, Leaf Spot, Pseudomonas Blight, Purple Blotch, Yellow Rust	0.9 – 1.8 (0.016 – 0.032 lbs. chitosan and 0.07 – 0.14 lbs. copper)	3.5 (0.061 lbs. chitosan and 0.27 lbs. copper)	Make fall applications after harvest. Apply delayed dormant spray after pruning/training in the spring. If needed, agricultural-type spray oil may be added. Minimum retreatment interval is 7 days.
	Anthracnose, Cane Spot, Leaf Spot, Purple Blotch, Yellow Rust	0.4 – 0.9 (0.007 – 0.016 lbs. chitosan and 0.03 – 0.07 lbs. copper)		Apply when leaf buds begin to open and repeat when flower buds show white. If needed, agricultural-type spray oil may be added. NOTE: Crop injury may occur if applied to foliage under certain environmental conditions such as hot or prolonged moist periods. Discontinue applications if signs of crop injury appear. Minimum retreatment interval is 7 days.

Crop	Disease	Use Rate in Pints Per Acre	Maximum Annual Rate in Pints per Acre	Application Instructions
Blueberries	Bacterial Canker	1.3 – 2.6 (0.023 – 0.046 lbs. chitosan and 0.10 – 0.20 lbs. copper)	5.3 (0.093 lbs. chitosan and 0.41 lbs. copper)	Make first application before fall rains and a second application 4 weeks later. Use the higher rates when conditions favor disease.
	Fruit Rot, Phomopsis Twig Blight	0.9 – 1.8 (0.016 – 0.032 lbs. chitosan and 0.07 – 0.14 lbs. copper)		Dormant Application: Begin applications when bloom buds begin to swell. Make additional applications at 10 to 14 day intervals or as needed before blooms open.
Cranberry	Fruit Rot	2.6 (0.046 lbs. chitosan and 0.20 lbs. copper)	7.9 (0.138 lbs. chitosan and 0.61 lbs. copper)	Make first application in late bloom. Apply one or two additional applications at 10 to 14 day intervals or as needed depending on disease severity.
	Rose Bloom			Apply three sprays on 10 to 14 day schedule or as needed as soon as symptoms are observed.
	Bacterial Stem Canker			Apply post-harvest and again in spring at bud swell. Apply one or two additional applications at 10 to 14 day intervals or as needed depending on disease severity.
	Leaf Blight, Red Leaf Spot Stem Blight, Tip Blight			Apply delayed dormant spray in the spring. Repeat at 10 to 14 day intervals or as needed through pre-bloom.
Currant, Gooseberry	Anthracnose, Leaf Spot	2.6 (0.046 lbs. chitosan and 0.20 lbs. copper)	7.9 (0.138 lbs. chitosan and 0.61 lbs. copper)	Make initial application after first leaves have expanded. Continue on a 10 to 14 day schedule or as needed during wet conditions in the spring. Make an additional application after harvest.
Raspberry	Anthracnose, Cane Spot, Leaf Spot, Pseudomonas Blight, Purple Blotch, Yellow Rust	0.9 – 1.8 (0.016 – 0.032 lbs. chitosan and 0.07 – 0.14 lbs. copper)	3.5 (0.061 lbs. chitosan and 0.27 lbs. copper)	Make fall application after harvest. Apply delayed dormant spray after training in the spring. If needed, agricultural-type spray oil may be added.
	Anthracnose, Cane Spot, Leaf Spot, Purple Blotch, Yellow Rust	0.4 – 0.9 (0.007 – 0.016 lbs. chitosan and 0.03 – 0.07 lbs. copper)		Apply when leaf buds begin to open and repeat when flower buds show white. If needed, agricultural-type spray oil may be added. NOTE: Crop injury may occur if applied to foliage under certain environmental conditions such as hot or prolonged moist periods. Discontinue applications if sign of crop injury appear.
Strawberry	Angular Leaf Spot (Xanthomonas) Leaf Blight, Leaf Scorch, Leaf Spot	0.4 – 0.9 (0.007 – 0.016 lbs. chitosan and 0.03 – 0.07 lbs. copper)	19.3 (0.338 lbs. chitosan and 1.49 lbs. copper)	Begin application when plants are established and continue on a weekly schedule throughout the season. Apply in at least 20 gallons of water. Use the higher rates when conditions favor disease. NOTE: Discontinue applications if signs of crop injury appear.

TREE FRUIT AND TREE NUTS

Crop	Disease	Use Rate in Pints Per Acre	Maximum Annual Rate in Pints per Acre	Application Instructions
Almonds Only	Bacterial Blast	0.4 (0.007 lbs. chitosan and 0.03 lbs. copper)	1.3 (0.023 lbs. chitosan and 0.10 lbs. copper)	**Almond Only:** For bacterial blast control in sprinkler irrigated orchards or where disease is severe, apply 0.4 pints per acre post-bloom at 2 week intervals or as needed or just before sprinkling. NOTE: Foliar injury may occur from post-bloom sprays on almonds, especially on NePlus Varieties. Minimum retreatment interval is 14 days.

Crop	Disease	Use Rate in Pints Per Acre	Maximum Annual Rate in Pints per Acre	Application Instructions
Almonds, Apricots, Cherry, Plum, Prune	Bacterial Blast (Pseudomonas), Bacterial Canker, Coryneum Blight (Shot Hole)	2.6 – 5.3 (0.046 – 0.093 lbs. chitosan and 0.20 – 0.41 lbs. copper)	10.5 (0.184 lbs. chitosan and 0.81 lbs. copper)	Make first application before fall rains and a second at late dormant. Use the higher rates when conditions favor disease. If needed, agricultural-type spray oil may be added. **For Cherries:** Where disease is severe, an additional application shortly after harvest may be required. Minimum retreatment interval is 7 days.
	Blossom Brown Rot, Coryneum Blight (Shot hole)	1.8 – 3.5 (0.032 – 0.061 lbs. chitosan and 0.14 – 0.27 lbs. copper)		Apply during early bloom. Do not apply after full bloom or injury may occur. Use the higher rates when rainfall is heavy and disease pressure is high. Minimum retreatment interval is 5 days.
	Black Knot (Plum)	1.3 – 2.6 (0.023 – 0.046 lbs. chitosan and 0.10 – 0.20 lbs. copper)		Make an application at bud swell up to early bloom for early season disease suppression. Apply before full bloom. Use the higher rates when rainfall is heavy and disease pressure is high. NOTE: To avoid plant injury, do not use after full bloom. Minimum retreatment interval is 7 days.
	Cherry Leaf Spot	1.8 – 2.6 (0.032 – 0.046 lbs. chitosan and 0.14 – 0.20 lbs. copper)		Apply at petal fall as well as 1 to 2 times after petal fall. Use the lower rates where disease infection is light and use the higher rates for a dormant application or where disease infection is moderate to heavy. As cherry varieties (such as sweet cherry and English Morello) differ in sensitivity to copper, always evaluate injury potential to BIOREND® Cu prior to treating orchards. Minimum retreatment interval is 7 days.
Apple	Anthracnose, Blossom Blast, European Canker (Nectria), Shoot Blast (Pseudomonas)	3.5 – 5.3 (0.061 – 0.093 lbs. chitosan and 0.27 – 0.41 lbs. copper)	13.2 (0.231 lbs. chitosan and 1.02 lbs. copper)	Fall application: Apply before fall rains. Use the higher rates when conditions favor disease. NOTE: Use on yellow varieties may cause discoloration. To avoid discoloration pick before spraying. Minimum retreatment interval is 7 days.
	Apple Scab, Fire Blight	2.6 – 5.3 (0.046 – 0.093 lbs. chitosan and 0.20 – 0.41 lbs. copper)		Fall/Late Dormant Application: Make application between silver-tip and green tip. Apply as a full cover spray for early season disease suppression. NOTE: Moderate to severe crop injury may occur from late application. After green tip reaches ½ inch, use only on varieties not prone to fruit russeting. Do not tank mix with acidifying surfactants or non-buffered phosphite fungicides. Do not apply BIOREND® Cu just prior to predicted frosts. Only 1 application per season is permitted.
	Apple Scab	0.4 – 1.3 (0.007 – 0.023 lbs. chitosan and 0.03 – 0.1 lbs. copper)	13.2 (0.231 lbs. chitosan and 1.02 lbs. copper)	Growing Season Application (**Extended spray schedule where fruit finish is not a concern)**: Continued applications may be made at 5 to 7 day intervals or as needed between ½ inch green-tip and first cover spray. The addition of spray oil may enhance coverage of the wood in dormant sprays. NOTE: Moderate to severe crop injury may result from this extended spray schedule depending on variety. Caution should be taken on varieties prone to fruit russetting. Minimum retreatment interval is 5 days.
	Fire Blight	0.4 – 1.3 (0.007 – 0.023 lbs. chitosan and 0.03 – 0.1 lbs. copper)		
	Collar Rot, Crown Rot	1.3 (0.023 lbs. chitosan and 0.1 lbs. copper)		Mix in 100 gallons of water. Apply 4 gallons of suspension as a drench on the lower trunk area of each tree. Apply in early spring or in fall after harvest for best results. Do not apply to foliage or fruit. NOTE: Do not use if soil pH is below 5.5 since copper toxicity may result. Minimum retreatment interval is 30 days.

Crop	Disease	Use Rate in Pints Per Acre	Maximum Annual Rate in Pints per Acre	Application Instructions
Avocado	Anthracnose, Blotch, Scab	1.8 – 3.5 (0.032 – 0.061 lbs. chitosan and 0.14 -0.27 lbs. copper)	21.1 (0.369 lbs. chitosan and 1.62 lbs. copper)	Growing Season Application: Apply when bloom buds begin to swell and continue application at monthly intervals for five to six applications. Use the higher rates when conditions favor disease. Minimum retreatment interval is 14 days.
Banana	Sigatoka (Black and Yellow)	1.3 (0.023 lbs. chitosan and 0.1 lbs. copper)	13.2 (0.231 lbs. chitosan and 1.02 lbs. copper)	Apply by air in 3 gallons of water. If needed, an agricultural-type spray oil may be added. Apply on a 14 day schedule or as needed throughout the wet season. Apply at 21 day intervals or as needed during dry periods. Minimum retreatment interval is 7 days.
	Black Pitting	1.3 (0.023 lbs. chitosan and 0.1 lbs. copper)		Mix in 100 gallons of water. Apply to the fruit stem and the basal portion of the leaf crown. Apply during the first and second weeks after fruit emergence. Minimum retreatment interval is 7 days.
Cacao	Black Pod	0.4 – 2.6 (0.007 – 0.046 lbs. chitosan and 0.03 – 0.2 lbs. copper)	13.2 (0.231 lbs. chitosan and 1.02 lbs. copper)	Begin applications at the start of the rainy season and continue while infections conditions persist. Apply 0.4 to 2.6 pts. at 14 to 21 day intervals or as needed depending on disease severity. For drier areas, make two to four applications using 2.2 to 3.3 pts. per acre according to disease incidence and planting density. Minimum retreatment interval is 14 days.
Coffee	Coffee Berry Disease (*Colletotrichum coffeanum*)	1.8 – 2.6 (0.032 – 0.046 lbs. chitosan and 0.032 – 0.046 lbs. copper)	13.2 (0.231 lbs. chitosan and 1.02 lbs. copper)	Apply first spray after flowering and before onset of long rains and then at 21 to 28 day intervals or as needed until picking. Use the higher rates when conditions favor disease. Minimum retreatment interval is 21 days.
	Bacterial Blight (*Pseudomonas syringae*)	1.8 – 2.6 (0.032 – 0.046 lbs. chitosan and 0.032 – 0.046 lbs. copper)		Begin spray program before the onset of long rainy periods and continue through the rainy season at 14 to 21 day intervals or as needed. The critical time for spraying to control this disease is just before, during and after flowering(s), especially when coinciding with wet weather. Use the higher rates when rainfall is heavy and disease pressure is high. Minimum retreatment interval is 14 days.
	Leaf Rust (*Hemileia vastatrix*)	0.4 – 1.3 (0.007 – 0.023 lbs. chitosan and 0.03 – 0.1 lbs. copper)		Apply before the onset of rain and then at 21 day intervals or as needed while the rains continue. Use the higher rates when rainfall is heavy and disease pressure is high. Minimum retreatment interval is 21 days.
	Iron Spot (*Cercospora coffeicola*), Pink Disease (*Corticium salmonicolor*)	0.4 – 0.9 (0.007 – 0.016 lbs. chitosan and 0.03 – 0.07 lbs. copper)		Use concentrate or dilute spray. Begin treatment at the start of wet season and continue at monthly intervals for three applications. Minimum retreatment interval is 30 days.
Filbert	Bacterial Blight	5.3 – 7.9 (0.093 – 0.138 lbs. chitosan and 0.41 – 0.61 lbs. copper)	31.6 (0.553 lbs. chitosan and 2.43 lbs. copper)	Apply as a post-harvest spray. In seasons of heavy rainfall, apply a second spray when three-fourths of the leaves have dropped. Use the higher rates when rainfall is heavy and disease pressure is high. If needed, agricultural type spray oil may be added. Minimum retreatment interval is 14 days.
	Eastern Filbert Blight	5.3 – 7.9 (0.093 – 0.138 lbs. chitosan and 0.41 – 0.61 lbs. copper)		Apply as a dilute spray in adequate water for thorough coverage. Make applications starting at bud swell to bud break and continue at 2-week intervals or as needed until early May. Thorough coverage is essential. Use the higher rates when rainfall is heavy and disease pressure is high. If needed, agricultural-type spray oil may be added. Minimum retreatment interval is 14 days.

Crop	Disease	Use Rate in Pints Per Acre	Maximum Annual Rate in Pints per Acre	Application Instructions
Mango	Anthracnose	1.3 – 2.6 (0.023 - 0.046 lbs. chitosan and 0.10 - 0.20 lbs. copper)	7.9 (0.138 lbs. chitosan and 0.61 lbs. copper)	Apply monthly after fruit set until harvest. Use the higher rates when rainfall is heavy and disease pressure is high. Minimum retreatment interval is 30 days.
Olives	Peacock Spot, Olive Knot	2.6 – 4.4 (0.046 – 0.077 lbs. chitosan and 0.20 – 0.34 lbs. copper)	8.8 (0.154 lbs. chitosan and 0.68 lbs. copper)	Make first application before winter rains begin. A second application in early spring should be made if disease is severe. Apply the higher rates for heavy disease pressure or when conditions favor disease development. Minimum retreatment interval is 30 days.
Peach, Nectarine	Bacterial Blast (*Pseudomonas*) Bacterial Canker, Bacterial Spot (*Xanthomonas*) Coryneum Blight (Shot Hole), Leaf Curl	2.6 – 5.3 (0.046 – 0.093 lbs. chitosan and 0.20 – 0.41 lbs. copper)	17.6 (0.308 lbs. chitosan and 1.36 lbs. copper)	Make first application before fall rains and a second at late dormant. For peach leaf curl, late dormant application must be made before leaf buds swell. Use the higher rates when rainfall is heavy and disease pressure is high. If needed, agricultural-type spray oil may be added. Minimum retreatment interval is 21 days.
	Blossom Brown Rot, Coryneum Blight (Shot Hole), Leaf Curl	1.8 – 3.5 (0.032 – 0.061 lbs. chitosan and 0.14 – 0.27 lbs. copper)		Full cover spray at pink bud. Use the higher rates when conditions favor disease. Evaluate fruit finish impact on susceptible varieties prior to use. Minimum retreatment interval is 5 days.
	Bacterial Spot	0.22 – 0.4 (0.004 – 0.007 lbs. chitosan and 0.02 – 0.03 lbs. copper)		**NOTE:** Spotting of leaves and defoliation may occur from use in cover sprays – varietal differences occur. Minimum retreatment interval is 7 days.
Pear	Fire Blight	0.4 (0.007 lbs. chitosan and 0.03 lbs. copper)	10.5 (0.184 lbs. chitosan and 0.81 lbs. copper)	Apply at 5 day intervals or as needed throughout the bloom period. NOTE: Russetting may occur in copper sensitive varieties. Excessive dosages may cause fruit russet on any variety. Minimum retreatment interval is 5 days.
	Blossom Blast (*Pseudomonas*)	3.5 – 5.3 (0.061 – 0.093 lbs. chitosan and 0.27 – 0.41 lbs. copper)		Apply before fall rains and again during dormancy before spring growth starts. Use the higher rates when disease pressure is high or when conditions favor disease development. Only one application is permitted.
Pecan	Kernel Rot, Shuck Rot, (*Phytophthora cactorum*) Zonate Leaf Spot (*Cristulariella pyramidalis*)	0.4 – 1.3 (0.007 – 0.023 lbs. chitosan and 0.03 – 0.1 lbs. copper)	5.3 (0.093 lbs. chitosan and 0.41 lbs. copper)	For suppression, apply in sufficient water to ensure complete spray coverage at 2 to 4 week intervals or as needed, starting at kernel growth and continue until shucks open. Use the higher rates and shorter spray intervals if frequent rainfall occurs. Minimum retreatment interval is 14 days.
	Ball Moss, Spanish Moss	1.8 – 2.6 (0.023 – 0.046 lbs. chitosan and 0.14 – 0.20 lbs. copper)		Apply in 100 gallons of water in the spring when ball moss is actively growing, using 1 ½ gallons of spray per foot of tree height. Make sure to wet ball moss tufts thoroughly. A second application may be required after 12 months. Minimum retreatment interval is 14 days.
Pistachio	Botryosphaeria Panicle and Shoot Blight, Botrytis Blight, Late Blight (*Alternaria alternata*) Septoria Leaf Blight	1.3 – 2.6 (0.032 – 0.046 lbs. chitosan and 0.14 – 0.20 lbs. copper)	7.9 (0.138 lbs. chitosan and 0.61 lbs. copper)	Make initial application at bud swell and repeat on a 14 to 28 day schedule or as needed. If disease conditions are severe, use the higher rates and shorter spray intervals. Minimum retreatment interval is 14 days.

Crop	Disease	Use Rate in Pints Per Acre	Maximum Annual Rate in Pints per Acre	Application Instructions
Quince	Fire Blight	0.4 (0.007 lbs. chitosan and 0.03 lbs. copper)	3.5 (0.061 lbs. chitosan and 0.27 lbs. copper)	Apply at 5 day intervals or as needed throughout the bloom period. Apply in adequate water for thorough coverage. Minimum retreatment interval is 5 days.
Walnuts	Walnut Blight	2.6 – 5.3 (0.046 – 0.093 lbs. chitosan and 0.20 – 0.41 lbs. copper)	26.3 (0.460 lbs. chitosan and 2.03 lbs. copper)	Apply first spray at early pre-bloom prior to or when catkins are partially expanded. Make additional applications during bloom and early nutlet stage or as needed when frequent rainfall or extended periods of moisture occur. Thorough coverage of catkins, leaves, and nutlets is essential for effective control. NOTE: Adequate control may not be obtained when copper tolerant species of *Xanthomonas* bacteria are present. Minimum retreatment interval is 7 days.

VEGETABLES

Crop	Disease	Use Rate in Pints Per Acre	Maximum Annual Rate in Pints per Acre	Application Instructions
Bean (Dry, Green)	Brown Spot, Common Blight, Halo Blight	0.4 – 0.9 (0.007 – 0.016 lbs. chitosan and 0.03 – 0.07 lbs. copper)	13.2 (0.231 lbs. chitosan and 1.02 lbs. copper)	For protective sprays, make first application when plants are 6 inches high; repeat on a 7 to 14 day schedule or as needed depending on environmental conditions. Use the higher rates for more severe disease. Minimum retreatment interval is 7 days.
Beet (Table Beet, Beet Greens)	Cercospora Leaf Spot	0.4 – 1.3 (0.007 – 0.023 lbs. chitosan and 0.03 – 0.1 lbs. copper)	5.3 (0.093 lbs. chitosan and 0.41 lbs. copper)	Begin applications when conditions first favor disease development and repeat at 10 to 14 day intervals or as needed. Use higher rates when conditions favor disease. Minimum retreatment interval is 10 days.
Carrot	Alternaria Leaf Spot, Cercospora Leaf Spot	0.4 – 1.3 (0.007 – 0.023 lbs. chitosan and 0.03 – 0.1 lbs. copper)	13.2 (0.231 lbs. chitosan and 1.02 lbs. copper)	Begin applications when disease first threatens and repeat at 7 to 14 day intervals or as needed depending on disease severity. Minimum retreatment interval is 7 days.
Celery, Celeriac	Bacterial Blight, Cercospora Early Blight, Septoria Late Blight	0.4 – 0.9 (0.007 – 0.016 lbs. chitosan and 0.03 – 0.07 lbs. copper)	5.3 (0.093 lbs. chitosan and 0.41 lbs. copper)	Begin applications as soon as plants are first established in the field, repeating at 5 to 7 day intervals or as needed depending on disease severity and environmental conditions. Minimum retreatment interval is 7 days.
Crucifers (Broccoli, Brussels Sprouts, Cabbage, Cauliflower, Collard Greens, Mustard Greens, Turnip Greens)	Black Leaf Spot (*Alternaria*) Black Rot (*Xanthomonas*) Downy Mildew	0.4 – 0.9 (0.007 – 0.016 lbs. chitosan and 0.03 – 0.07 lbs. copper)	5.3 (0.093 lbs. chitosan and 0.41 lbs. copper)	Begin application after transplants are set in the field, or shortly after emergence of field seeded crops or when conditions favor disease development. Apply at 7 to 10 day intervals or as needed. Use the higher rates when conditions favor disease. NOTE: Reddening of older leaves may occur on broccoli and a flecking of wrapper leaves may occur on cabbage. Minimum retreatment interval is 7 days.
Cucurbits (Cantaloupe, Cucumber, Honeydew, Muskmelon, Pumpkin, Squash, Watermelon)	Alternaria Leaf Spot, Angular Leaf Spot, Anthracnose, Downy Mildew, Gummy Stem Blight, Powdery Mildew, Watermelon	0.4 – 0.9 (0.007 – 0.016 lbs. chitosan and 0.03 – 0.07 lbs. copper)	13.2 (0.231 lbs. chitosan and 1.02 lbs. copper)	Begin applications prior to disease development and continue while conditions are favorable for disease development. Repeat at 5 to 7 day intervals or as needed. Use the higher rates when conditions favor disease. NOTE: Crop injury may occur from application at higher rates and shorter intervals. Discontinue use if injury occurs. Minimum retreatment interval is 5 days.

	Bacterial Fruit Blotch (suppression)			
Crop	**Disease**	**Use Rate in Pints Per Acre**	**Maximum Annual Rate in Pints per Acre**	**Application Instructions**
Eggplant	Alternaria Blight, Anthracnose Phomopsis	0.4 – 1.3 (0.007 – 0.023 lbs. chitosan and 0.03 – 0.1 lbs. copper)	7.9 (0.138 lbs. chitosan and 0.61 lbs. copper)	Begin applications prior to development of disease symptoms. Repeat spray at 7 to 10 day intervals or as needed depending on disease severity. Minimum retreatment interval is 7 days.
Okra	Anthracnose, Bacterial Leaf Spot,Leaf Spots, Pod Spot, Powdery Mildew	0.4 – 1.3 (0.007 – 0.023 lbs. chitosan and 0.03 – 0.1 lbs. copper)	7.9 (0.138 lbs. chitosan and 0.61 lbs. copper)	Begin treatment when disease first threatens and repeat every 5 to 10 days or as needed depending on disease severity. Use the higher rates and shorter spray intervals when conditions favor disease. Minimum retreatment interval is 5 days.
Onion, Garlic	Bacterial Blight, Downy Mildew, Purple Blotch	0.4 – 1.3 (0.007 – 0.023 lbs. chitosan and 0.03 – 0.1 lbs. copper)	13.2 (0.231 lbs. chitosan and 1.02 lbs. copper)	Begin when plants are 4 to 6 inches high and repeat at 7 to 10 day intervals or as needed depending on disease severity. Can cause phytotoxicity to leaves. Minimum retreatment interval is 7 days.
Pea	Powdery Mildew	0.4 – 0.9 (0.007 – 0.016 lbs. chitosan and 0.03 – 0.07 lbs. copper)	6.1 (0.107 lbs. chitosan and 0.47 lbs. copper)	Begin applications when disease symptoms first appear and repeat at weekly intervals or as needed. Use the higher rates when conditions favor disease. Minimum retreatment interval is 7 days.
Pepper	Anthracnose, Bacterial Spot, Cercospora Leaf Spot	0.4 – 2.6 (0.007 – 0.046 lbs. chitosan and 0.03 – 0.2 lbs. copper)	26.3 (0.460 lbs. chitosan and 2.03 lbs. copper)	Begin applications when condition first favor disease development and repeat at 7 to 10 day intervals or as needed depending on disease severity. Use the higher rates when conditions favor disease. Minimum retreatment interval is 3 days.
Spinach	Anthracnose, Blue Mold, Cercospora Leaf Spot, White Rust	0.4 – 0.9 (0.007 – 0.016 lbs. chitosan and 0.03 – 0.07 lbs. copper)	4.4 (0.077 lbs. chitosan and 0.34 lbs. copper)	Begin application when disease first appears or when conditions favor disease development. Repeat at 7 to 10 day intervals or as needed. Use the higher rates when conditions favor disease. NOTE: Flecking may occur in spinach leaves. Minimum retreatment interval is 7 days.
Tomato	Anthracnose, Bacterial Speck, Bacterial Spot, Early Blight Gray Leaf Mold, Late Blight, Septoria Leaf Spot	0.4 – 2.6 (0.007 – 0.046 lbs. chitosan and 0.03 – 0.2 lbs. copper)	35.1 (0.614 lbs. chitosan and 2.70 lbs. copper)	Begin applications when disease first threatens and repeat at 5 to 10 day intervals or as needed depending on disease severity. Use the higher rates when conditions favor disease. Minimum retreatment interval is 3 days.
Watercress	Cercospora Leaf Spot	0.4 – 0.9 (0.007 – 0.016 lbs. chitosan and 0.03 – 0.07 lbs. copper)	3.5 (0.061 lbs. chitosan and 0.27 lbs. copper)	Begin applications when plants are first established in the field, repeating at 7 to 14 day intervals or as needed depending on disease severity. Do not exceed 4 applications per crop. Apply using ground spray equipment at no less than 50 gallons of spray solution per acre. Minimum retreatment interval is 7 days.

VINES

Crop	Disease	Use Rate in Pints Per Acre	Maximum Annual Rate in Pints per Acre	Application Instructions
Grapes	Block Rot, Downy Mildew, Phomopis	0.9 – 2.6 (0.016 – 0.046 lbs. chitosan and 0.07 – 0.20 lbs. copper)	26.3 (0.460 lbs. chitosan and 2.03 lbs. copper)	Begin applications at bud break with subsequent applications throughout the season depending on disease severity. Use the higher rates when conditions favor disease. NOTE: Foliage injury may occur on copper sensitive varieties such as Concord, Delaware, Niagara and Rosette. Minimum retreatment interval is 3 days.
	Powdery Mildew	1.8 – 2.6 (0.032 – 0.046 lbs. chitosan and 0.14 – 0.2 lbs. copper)		
Hops	Downy Mildew	0.4 – 0.9 (0.007 – 0.016 lbs. chitosan and 0.03 – 0.07 lbs. copper)	5.3 (0.093 lbs. chitosan and 0.41 lbs. copper)	Make crown treatment after pruning, but before training. After training, additional treatments are needed at about 10 day intervals. NOTE: Discontinue use 2 weeks before harvest. Minimum retreatment interval is 10 days.
Kiwi	*Erwinia herbicola*, *Pseudomonas fluorescens*, *Pseudomonas syringae*	1.3 – 2.6 (0.023 – 0.046 lbs. chitosan and 0.10 – 0.20 lbs. copper)	7.9 (0.138 lbs. chitosan and 0.61 lbs. copper)	Apply in 200 gallons of water per acre. Make applications on a monthly basis. A maximum of three applications may be made. Minimum retreatment interval is 30 days.

MISCELLANEOUS

Crop	Disease	Use Rate in Pints Per Acre	Maximum Annual Rate in Pints per Acre	Application Instructions
Atemoya	Anthracnose	0.4 – 0.9 (0.007 – 0.016 lbs. chitosan and 0.03 – 0.07 lbs. copper)	6.1 (0.107 lbs. chitosan and 0.47 lbs. copper)	Make initial application just before flowering and repeat on a weekly schedule until just before harvest. Apply in sufficient water for thorough coverage. Use the higher rates for severe disease. Minimum retreatment interval is 7 days.
Carambola	Anthracnose	1.8 – 2.6 (0.032 – 0.046 lbs. chitosan and 0.14 – 0.2 lbs. copper)	7.9 (0.138 lbs. chitosan and 0.61 lbs. copper)	Make initial application just before flowering and repeat on a weekly schedule until just before harvest. Apply in sufficient water for thorough coverage. Use the higher rates for severe disease. Minimum retreatment interval is 7 days.
Chives	Downy Mildew	0.4 – 0.9 (0.007 – 0.016 lbs. chitosan and 0.03 – 0.07 lbs. copper)	4.4 (0.077 lbs. chitosan and 0.34 lbs. copper)	Begin applications when plants are established in the field. Repeat applications every 7 to 10 days or as needed depending on disease conditions. Minimum retreatment interval is 7 days.
Dill	Phoma Leaf Spot, Rhizoctonia Foliage Blight	0.4 – 0.9 (0.007 – 0.016 lbs. chitosan and 0.03 – 0.07 lbs. copper)	4.4 (0.077 lbs. chitosan and 0.34 lbs. copper)	Begin applications when plants are first established in the field and repeat at 7 to 10 day intervals or as needed depending upon disease severity and environmental conditions. Use the higher rates when conditions favor disease. Minimum retreatment interval is 7 days.

Crop	Disease	Use Rate in Pints Per Acre	Maximum Annual Rate in Pints per Acre	Application Instructions
Ginseng	Alternaria Leaf Blight, Stem Blight	0.4 – 1.3 (0.007 – 0.023 lbs. chitosan and 0.03 – 0.1 lbs. copper)	5.3 (0.093 lbs. chitosan and 0.41 lbs. copper)	Use as a tank mix with 1 lb. Iprodione in 100 gallons of water. Use in accordance with the most restrictive of label limitations and precautions. No label dosage rates should exceeded. This product cannot be mixed with any product containing a label prohibition against such mixing. Begin BIOREND® Cu -Iprodione applications as soon as plants have emerged in spring. Applications should be repeated every 7 days or as needed until plants become dormant in fall. Apply fungicides at least 8 hours before rain. Use of a spread-sticker or sticker is advised. NOTE: Alternaria Leaf and Stem Blight is most severe in humid conditions such as those found in the dense canopies of 2 to 4 year old Ginseng. It is very important that the stems be thoroughly covered with fungicide; therefore, use a spray apparatus which distributes the fungicide throughout the canopy. Minimum retreatment interval is 7 days.
Guava	Anthracnose, Red Algae	0.4 – 1.3 (0.007 – 0.023 lbs. chitosan and 0.03 – 0.1 lbs. copper)	5.3 (0.093 lbs. chitosan and 0.41 lbs. copper)	Make initial application just before flowering and repeat on a weekly schedule until just before harvest. Apply in sufficient water for thorough coverage. Use the higher rates for severe disease. Minimum retreatment interval is 7 days.
Litchi	Anthracnose	0.4 – 1.3 (0.007 – 0.023 lbs. chitosan and 0.03 – 0.1 lbs. copper)	5.3 (0.093 lbs. chitosan and 0.41 lbs. copper)	Make initial application just before flowering and repeat on a weekly schedule until just before harvest. Apply in sufficient water for thorough coverage. Use the higher rates for severe disease. Minimum retreatment interval is 7 days.
Macadamia	Anthracnose	1.3 – 2.6 (0.023 – 0.046 lbs. chitosan and 0.10 – 0.20 lbs. copper)	10.5 (0.184 lbs. chitosan and 0.81 lbs. copper)	Initiate sprays at first sign of flowering and repeat on a weekly schedule until just before harvest. Apply in sufficient water for thorough coverage. Use the higher rates when conditions favor disease. Minimum retreatment interval is 7 days.
	Phytophthora Blight (*P. capsici*), Raceme Blight (*Boytrytis cinerea*)	0.9 – 1.8 (0.016 – 0.032 lbs. chitosan and 0.07 – 0.14 lbs. copper)	8.8 (0.154 lbs. chitosan and 0.68 lbs. copper)	Apply during aceme development and bloom periods. Apply in sufficient water for thorough coverage. Use the higher rates when conditions favor disease. Minimum retreatment interval is 7 days.
Mamey, Sapote	Algal Leaf Spot, Anthracnose	1.8 – 2.6 (0.032 – 0.046 lbs. chitosan and 0.032 – 0.046 lbs. copper)	7.9 (0.138 lbs. chitosan and 0.61 lbs. copper)	Apply when conditions favor disease development. Repeat on 14 to 30 day schedule or as needed as disease severity and environmental conditions dictate. Use the higher rates when conditions favor disease. Minimum retreatment interval is 14 days.
Papaya	Anthracnose	1.3 – 2.6 (0.023 – 0.046 lbs. chitosan and 0.10 – 0.20 lbs. copper)	10.5 (0.184 lbs. chitosan and 0.81 lbs. copper)	Apply before disease appears. Apply at 10 to 14 day intervals under light disease pressure and 5 to 7 day intervals or as needed under heavy disease pressure. The addition of an approved spreader is desirable. Use the higher rates when conditions favor disease. Minimum retreatment interval is 7 days.
Parsley	Bacterial Blight (*Pseudomonas sp.)*	0.4 – 1.3 (0.007 – 0.023 lbs. chitosan and 0.03 – 0.1 lbs. copper)	5.3 (0.093 lbs. chitosan and 0.41 lbs. copper)	Begin applications when plants are first established in the field and repeat at 10 day intervals or as needed depending on disease severity and environmental conditions. Minimum retreatment interval is 10 days.
Passion Fruit	Anthracnose	1.3 – 2.6 (0.023 – 0.046 lbs. chitosan and 0.10 – 0.20 lbs. copper)	10.5 (0.184 lbs. chitosan and 0.81 lbs. copper)	Make initial application just before flowering and repeat on a weekly schedule until just before harvest. Apply in sufficient water for thorough coverage. Use the higher rates for severe disease. Minimum retreatment interval is 7 days.

Crop	Disease	Use Rate in Pints Per Acre	Maximum Annual Rate in Pints per Acre	Application Instructions
Sugar Apple (*Annona*)	Anthracnose	2.6 – 5.3 (0.046 – 0.093 lbs. chitosan and 0.20 – 0.41 lbs. copper)	21.1 (0.369 lbs. chitosan and 1.62 lbs. copper)	Make initial application just before flowering and repeat on a weekly schedule until just before harvest. Apply in sufficient water for thorough coverage. Use the higher rates for severe disease. Minimum retreatment interval is 7 days.
Sycamore	Anthracnose	0.4 – 0.9 (0.007 – 0.016 lbs. chitosan and 0.03 – 0.07 lbs. copper)	5.3 (0.093 lbs. chitosan and 0.41 lbs. copper)	Apply as a full cover spray in 100 gallons of water or sufficient volume for thorough coverage. Make first application at bud crack and second application 7 to 10 days later at 10% leaf expansion. Use the higher rates when conditions favor disease. Minimum retreatment interval is 7 days.

ORNAMENTAL PLANTS

Greenhouse, Field, Landscape and Interior: Annual & Perennial Bedding Plants, Potted Flowering Crops, Tropical Foliage, Cut Flower Crops & Nursery Crops

Restriction: Do not apply to trees that will bear fruit within one year.

Spray for thorough foliage coverage. Re-spray rates and intervals vary with severity of disease and adversity of environmental conditions. Lower rates may be as effective as higher rates and should be tried first. Routine preventive programs may be maintained at the lower rates.

Rates above 13 fl. oz. BIOREND® Cu per 100 gallons water may damage some tender, open blooms. Rates up to 61 fl. oz. BIOREND® Cu per 100 gallons water can be used for powdery mildew on roses if no blooms are open. Use of low volume equipment is effective against Botrytis and not effective against established powdery mildew and *Xanthomonas* infections.

Applications on actively growing tissue may be more effective than applications on dormant tissue.

For a single application, do not exceed 2.0 lbs. metallic copper per acre. Do not exceed 20 lbs. metallic copper per acre per year. BIOREND® Cu contains 0.62 lbs. of metallic copper per gallon of product. The minimum retreatment interval is 7 days.

For a single application to Easter lilies, do not exceed 2.5 lbs. metallic copper per acre. Do not exceed 75 lbs. metallic copper per acre per year. The minimum retreatment interval is 7 days. Do not apply any additional copper pesticide to this label for 36 months for field grown Easter lilies.

Annual & Perennial Bedding Plants

Crop	Disease	Use Rate in fl. oz. per 100 gallons	Lbs. A.I./100 gallons	Minimum Retreatment Interval
Alyssum	Botrytis	9 - 18	0.01 – 0.02 lbs. chitosan and 0.043 – 0.086 lbs. copper	7 days
	Downy Mildew	9 - 18		
Argyranthemum	Botrytis	11 - 18	0.012 – 0.02 lbs. chitosan and 0.053 – 0.086 lbs. copper	
	Erwinia	11 - 18		
Begonia	Botrytis	11 - 18		
	Powdery Mildew	13 - 18	0.014 – 0.02 lbs. chitosan and 0.0624 – 0.086 lbs. copper	
	Xanthaomonas	13 - 18		
Chrysanthemum	Botrytis	13 - 22	0.014 – 0.024 lbs. chitosan and 0.0624 – 0.106 lbs. copper	
	Pseudomonoas	13 - 22		
Daylily	Botrytis	11 - 18	0.012 – 0.02 lbs. chitosan and 0.053 – 0.086 lbs. copper	
	Erwinia	13 – 22	0.014 – 0.024 lbs. chitosan and 0.062 – 0.106 lbs. copper	
	Powdery Mildew	13 – 22		
Dusty Miller	Alternaria	13 – 22		
	Botrytis	11 - 18	0.012 – 0.02 lbs. chitosan and 0.053 – 0.086 lbs. copper	
Fuschia	Botrytis	11 - 18		
	Powdery Mildew	11 - 22	0.012 – 0.024 lbs. chitosan and 0.053 – 0.106 lbs. copper	
Geranium	Botrytis	13 - 18	0.014 – 0.02 lbs. chitosan and 0.0624 – 0.086 lbs. copper	
	Rust (preventive)	13 - 18		
	Rust (therapeutic)	22 - 35	0.024 – 0.039 lbs. chitosan and 0.106 – 0.17 lbs. copper	
	Pseudomonas (preventive)	13 - 40	0.014 – 0.044 lbs. chitosan and 0.0624 – 0.19 lbs. copper	
	Psuedomonas (therapeutic)	44	0.048 lbs. chitosan and 0.21 lbs. copper	
	Xanthomonas (preventive)	13 - 40	0.014 – 0.044 lbs. chitosan and 0.0624 – 0.19 lbs. copper	
	Xanthomonas (therapeutic)	44	0.048 lbs. chitosan and 0.21 lbs. copper	
Hollyhock	Botrytis	11 - 18	0.012 – 0.02 lbs. chitosan and 0.053 – 0.086 lbs. copper	
	Powdery Mildew	13 - 22	0.014 – 0.024 lbs. chitosan and 0.0624 – 0.106 lbs. copper	
	Rust	13 - 22		
Hosta	Botrytis	13 - 18	0.014 – 0.02 lbs. chitosan and 0.0624 – 0.086 lbs. copper	
	Erwinia	13 - 26	0.014 – 0.029 lbs. chitosan and 0.062 – 0.125 lbs. copper	
Impatiens	Alternaria	13 - 31	0.014 – 0.034 lbs. chitosan and 0.062 – 0.149 lbs. copper	
	Botrytis	11 - 13	0.012 – 0.014 lbs. chitosan and 0.053 – 0.062 lbs. copper	
	Powdery Mildew	11 - 22	0.012 – 0.024 lbs. chitosan and 0.053 – 0.106 lbs. copper	
	Pseudomonas	13 - 31	0.014 – 0.034 lbs. chitosan and 0.062 – 0.149 lbs. copper	
New Guinea Impatiens	Botrytis	11 - 13	0.012 – 0.014 lbs. chitosan and 0.053 – 0.062 lbs. copper	
	Powdery Mildew	11 - 18	0.012 – 0.02 lbs. chitosan and 0.053 – 0.086 lbs. copper	
Pachysandra	Botrytis	11 - 18		
	Volutella	11 - 22	0.012 – 0.024 lbs. chitosan and 0.053 – 0.106 lbs. copper	

Annual & Perennial Bedding Plants (Cont.)

Crop	Disease	Use Rate in fl. oz. per 100 gallons	Lbs. A.I./100 gallons	Minimum Retreatment Interval
Pansy	Botrytis	11 - 18	0.012 – 0.02 lbs. chitosan and 0.053 – 0.086 lbs. copper	7 days
	Cercospora	13 - 18	0.014 – 0.02 lbs. chitosan and 0.062 – 0.086 lbs. copper	
	Phytophthora	11 - 18	0.012 – 0.02 lbs. chitosan and 0.053 – 0.086 lbs. copper	
Periwinkle	Botrytis	11 - 18		
	Phytophthora	13 - 18	0.014 – 0.02 lbs. chitosan and 0.062 – 0.086 lbs. copper	
Ranunculus	Bacterial Blight	11 - 18	0.012 – 0.02 lbs. chitosan and 0.053 – 0.086 lbs. copper	
	Botrytis	11 - 18		
	Powdery Mildew	13 - 22	0.014 – 0.024 lbs. chitosan and 0.062 – 0.106 lbs. copper	
Snapdragon	Botrytis	11 - 18	0.012 – 0.02 lbs. chitosan and 0.053 – 0.086 lbs. copper	
	Downy Mildew	11 - 22	0.012 – 0.024 lbs. chitosan and 0.053 – 0.106 lbs. copper	
	Rust	11 - 22		
Zinnia	Botrytis	11 - 18	0.012 – 0.02 lbs. chitosan and 0.053 – 0.086 lbs. copper	
	Powdery Mildew	11 - 22	0.012 – 0.024 lbs. chitosan and 0.053 – 0.106 lbs. copper	
	Pseudomonas	11 - 22		
	Xanthomonas	11 - 22		
<u>Additional Annuals & Perennials</u> Anemone, Aster, Bacopa, Baptisia, Carnation, Coleus, Columbine, Coneflower, Coreopsis, Cuphea, Dahlia, Daisy, Dianthus, Delphinium, Echinacea, Ipomoea, Lantana, Lead Plant, Liatris, Lobelia, Lupine, Marigold, Monarda, Ornamental Grasses, Pentas, Petunia, Phlox, Poppy, Prairie Smoke, Primrose, Pulmonaria, Rudbeckia, Salvia, Scabiosa, Sedum, Silphium, Verbena, Veronica, Vinca, Viola	Botrytis	11 - 18	0.012 – 0.02 lbs. chitosan and 0.053 – 0.086 lbs. copper	
	Downy Mildew	13 - 26	0.014 – 0.029 lbs. chitosan and 0.0624 – 0.125 lbs. copper	
	Powdery Mildew	13 - 22	0.014 – 0.024 lbs. chitosan and 0.062 – 0.106 lbs. copper	
	Pseudomonas	13 - 22		

Potted Flowering Crops

Crop	Disease	Use Rate in fl. oz. per 100 gallons	Lbs. A.I./100 gallons	Minimum Retreatment Interval
African Violet	Botrytis	11 - 13	0.012 – 0.014 lbs. chitosan and 0.053 – 0.062 lbs. copper	7 days
	Powdery Mildew	11 - 13		
Azalea	Botrytis	11 - 22	0.012 – 0.024 lbs. chitosan and 0.053 – 0.106 lbs. copper	
	Colletotrichum	13 - 22	0.014 – 0.024 lbs. chitosan and 0.062 – 0.106 lbs. copper	
	Cylindrocladium	13 - 31	0.014 – 0.034 lbs. chitosan and 0.062 – 0.149 lbs. copper	
Calla Lily	Botrytis	11 - 18	0.012 – 0.02 lbs. chitosan and 0.053 – 0.086 lbs. copper	
	Erwinia	11 - 18		
Chrysanthemum	Botrytis	13 - 22	0.014 – 0.024 lbs. chitosan and 0.062 – 0.106 lbs. copper	
	Crown Gall	13 - 22		
	Erwinia	13 - 22		
	Powdery Mildew	13 - 22		
Cineraria	Botrytis	11 - 18	0.012 – 0.02 lbs. chitosan and 0.053 – 0.086 lbs. copper	
Cyclamen	Botrytis	13 - 18	0.014 – 0.02 lbs. chitosan and 0.062 – 0.086 lbs. copper	
	Erwinia	13 - 18		
Daffodil	Botrytis	11 - 18	0.012 – 0.02 lbs. chitosan and 0.053 – 0.086 lbs. copper	
Easter Lily	Botrytis	11 - 18		
Exacum	Botrytis	11 - 18		
Gerbera	Botrytis	13 - 22	0.014 – 0.024 lbs. chitosan and 0.062 – 0.106 lbs. copper	
	Powdery Mildew	13 - 22		
Gloxinia	Botrytis	11 - 18	0.012 – 0.02 lbs. chitosan and 0.053 – 0.086 lbs. copper	
Holiday Cactus	Botrytis	11 - 22	0.012 – 0.024 lbs. chitosan and 0.053 – 0.106 lbs. copper	
	Erwinia	13 - 44	0.014 – 0.048 lbs. chitosan and 0.062 – 0.21 lbs. copper	
	Psuedomonas	13 - 44		
	Xanthomonas	13 - 44		
Hyacinth	Botrytis	11 - 18	0.012 – 0.02 lbs. chitosan and 0.053 – 0.086 lbs. copper	
Hydrangea	Botrytis	11 - 22	0.012 – 0.024 lbs. chitosan and 0.053 – 0.106 lbs. copper	
	Powdery Mildew	11 - 22		
Iris	Botrytis	11 - 18	0.012 – 0.02 lbs. chitosan and 0.053 – 0.086 lbs. copper	
	Erwinia	13 - 18	0.014 – 0.02 lbs. chitosan and 0.062 – 0.086 lbs. copper	
Kalanchoe	Botrytis	13 - 22	0.014 – 0.024 lbs. chitosan and 0.062 – 0.106 lbs. copper	
	Erwinia	13 - 31	0.014 – 0.034 lbs. chitosan and 0.062 – 0.149 lbs. copper	
	Powdery Mildew	13 - 31		
Lisianthus	Botrytis	11 - 18	0.012 – 0.02 lbs. chitosan and 0.053 – 0.086 lbs. copper	

Potted Flowering Crops (Cont.)

Crop	Disease	Use Rate in fl. oz. per 100 gallons	Lbs. A.I./100 gallons	Minimum Retreatment Interval
Orchid	Botrytis	11 - 13	0.012 – 0.014 lbs. chitosan and 0.053 – 0.062 lbs. copper	7 days
	Erwinia	13 - 35	0.014 – 0.039 lbs. chitosan and 0.062 – 0.17 lbs. copper	
	Psuedomonas	13 - 35		
	Xanthomonas	13 - 35		
Poinsettia	Botrytis	13 - 18	0.014 – 0.02 lbs. chitosan and 0.062 – 0.086 lbs. copper	
	Scab	18 - 31	0.02 – 0.034 lbs. chitosan and 0.086 – 0.15 lbs. copper	
	Powdery Mildew (preventive)	13 - 18	0.014 – 0.02 lbs. chitosan and 0.062 – 0.086 lbs. copper	
	Powdery Mildew (therapeutic)	18 - 31	0.02 – 0.034 lbs. chitosan and 0.086 – 0.15 lbs. copper	
	Erwinia (preventive)	13 - 18	0.014 – 0.02 lbs. chitosan and 0.062 – 0.086 lbs. copper	
	Erwinia (therapeutic)	18 - 31	0.02 – 0.034 lbs. chitosan and 0.086 – 0.15 lbs. copper	
	Xanthomonas (preventive)	13 - 18	0.014 – 0.02 lbs. chitosan and 0.062 – 0.086 lbs. copper	
	Xanthomonas (therapeutic)	18 - 31	0.02 – 0.034 lbs. chitosan and 0.086 – 0.15 lbs. copper	
Primula	Botrytis	11 - 18	0.012 – 0.02 lbs. chitosan and 0.053 – 0.086 lbs. copper	
	Erwinia	13 - 18	0.014 – 0.02 lbs. chitosan and 0.062 – 0.086 lbs. copper	
Rose Bush	Black Spot (preventive)	13 – 26	0.014 – 0.029 lbs. chitosan and 0.062 – 0.125 lbs. copper	
	Black Spot (therapeutic)	31 - 44	0.034 – 0.048 lbs. chitosan and 0.15 – 0.21 lbs. copper	
	Botrytis (preventive)	13 - 18	0.014 – 0.02 lbs. chitosan and 0.062 – 0.086 lbs. copper	
	Botrytis (therapeutic)	22 - 44	0.024 – 0.048 lbs. chitosan and 0.106 – 0.021 lbs. copper	
	Cylindrocladium (preventive)	13 - 18	0.014 – 0.02 lbs. chitosan and 0.062 – 0.086 lbs. copper	
	Cylindrocladium (therapeutic)	22 - 44	0.024 – 0.048 lbs. chitosan and 0.106 – 0.021 lbs. copper	
	Downy Mildew (preventive)	13 - 18	0.014 – 0.02 lbs. chitosan and 0.062 – 0.086 lbs. copper	
	Downy Mildew (therapeutic)	22 - 44	0.024 – 0.048 lbs. chitosan and 0.106 – 0.021 lbs. copper	
	Powdery Mildew (preventive)	13 - 26	0.014 – 0.029 lbs. chitosan and 0.062 – 0.125 lbs. copper	
	Powdery Mildew (therapeutic)	31 - 44	0.034 – 0.048 lbs. chitosan and 0.15 – 0.21 lbs. copper	
Tulip	Botrytis	11 - 18	0.012 – 0.02 lbs. chitosan and 0.053 – 0.086 lbs. copper	

Nursery Crops

Crop	Disease	Use Rate in fl. oz. per 100 gallons	Lbs. A.I./100 gallons	Minimum Retreatment Interval
Azalea	Anthracnose	13 - 22	0.014 – 0.024 lbs. chitosan and 0.062 – 0.106 lbs. copper	7 days
	Botrytis	11 - 22	0.012 – 0.024 lbs. chitosan and 0.053 – 0.106 lbs. copper	
	Cylindrocladium	13 - 31	0.014 – 0.034 lbs. chitosan and 0.062 – 0.149 lbs. copper	
	Phytophthora	18 - 22	0.02 – 0.024 lbs. chitosan and 0.086 – 0.106 lbs. copper	
Buxus	Volutella	13 - 22	0.014 – 0.024 lbs. chitosan and 0.062 – 0.106 lbs. copper	
Cherry Laurel	Xanthomonas	18 - 31	0.02 – 0.034 lbs. chitosan and 0.086 – 0.15 lbs. copper	
Conifers	Botrytis	11 - 22	0.012 – 0.024 lbs. chitosan and 0.053 – 0.106 lbs. copper	
	Dipodia	9 - 11	0.01 – 0.012 lbs. chitosan and 0.043 – 0.053 lbs. copper	
Crape Myrtle	Botrytis	11 - 22	0.012 – 0.024 lbs. chitosan and 0.053 – 0.106 lbs. copper	
	Powdery Mildew	18 - 26	0.02 – 0.029 lbs. chitosan and 0.086 – 0.125 lbs. copper	
Dogwood	Anthracnose	18 - 26		
	Botrytis	11 - 22	0.012 – 0.024 lbs. chitosan and 0.053 – 0.106 lbs. copper	
	Powdery Mildew	18 - 26	0.02 – 0.029 lbs. chitosan and 0.086 – 0.17 lbs. copper	
Elm	Erwinia	18 - 35	0.02 – 0.039 lbs. chitosan and 0.086 – 0.125 lbs. copper	
Euonymus	Anthracnose	13 - 26	0.014 – 0.029 lbs. chitosan and 0.062 – 0.125 lbs. copper	
	Botrytis	11 - 22	0.012 – 0.024 lbs. chitosan and 0.053 – 0.106 lbs. copper	
Hawthorn	Cedar Apple Rust	13 - 22	0.014 – 0.024 lbs. chitosan and 0.062 – 0.106 lbs. copper	
Hydrangea	Botrytis	11 - 22	0.012 – 0.024 lbs. chitosan and 0.053 – 0.106 lbs. copper	
	Cercospora	13 - 22	0.014 – 0.024 lbs. chitosan and 0.062 – 0.106 lbs. copper	
	Powdery Mildew	11 - 22	0.012 – 0.024 lbs. chitosan and 0.053 – 0.106 lbs. copper	
Indian Hawthorn	Botrytis	11 - 22		
	Entomosporium	13 - 26	0.014 – 0.029 lbs. chitosan and 0.062 – 0.125 lbs. copper	
Japanese Maple	Botrytis	11 - 22	0.012 – 0.024 lbs. chitosan and 0.053 – 0.106 lbs. copper	
	Verticillium	13 - 22	0.014 – 0.024 lbs. chitosan and 0.062 – 0.106 lbs. copper	
	Pseudomonas	13 - 22		
Juniper	Phomopsis	11 - 22	0.012 – 0.024 lbs. chitosan and 0.053 – 0.106 lbs. copper	
Leyland Cypress	Cercospora	11 - 22		
Lilac	Botrytis	11 - 22		
	Pseudomonas	11 - 22		
	Powdery Mildew	13 - 22	0.014 – 0.024 lbs. chitosan and 0.062 – 0.106 lbs. copper	
Nandina	Xanthomonas	13 - 22		

Nursery Crops (Cont.)

Crop	Disease	Use Rate in fl. oz. per 100 gallons	Lbs. A.I./100 Gallons	Minimum Retreatment Interval
Oak	Anthracnose	31	0.034 lbs. chitosan and 0.15 lbs. copper	7 days
	Botrytis	11 - 22	0.012 – 0.024 lbs. chitosan and 0.053 – 0.106 lbs. copper	
Oak Trunk Spray	Phytophthora	26 - 40	0.029 – 0.044 lbs. chitosan and 0.125 – 0.19 lbs. copper	
Photinia	Entomosporium	13 - 26	0.014 – 0.029 lbs. chitosan and 0.062 – 0.125 lbs. copper	
Pinus	Dothistroma	13 - 22	0.014 – 0.024 lbs. chitosan and 0.062 – 0.106 lbs. copper	
Rosaceae: Cotoneaster, Malus, Mountain Ash, Ornamental Crabapple, Ornamental Pear, Pyracantha	Apple Scab	35	0.039 lbs. chitosan and 0.17 lbs. copper	
	Botrytis	11 - 22	0.012 – 0.024 lbs. chitosan and 0.053 – 0.106 lbs. copper	
	Fireblight	18 - 35	0.02 – 0.039 lbs. chitosan and 0.086 – 0.17 lbs. copper	
	Pseudomonas	13 - 31	0.014 – 0.034 lbs. chitosan and 0.062 – 0.149 lbs. copper	
Rhododendron	Botrytis	11 - 22	0.012 – 0.024 lbs. chitosan and 0.053 – 0.106 lbs. copper	
	Cylindrocladium	13 - 31	0.014 – 0.034 lbs. chitosan and 0.062 – 0.149 lbs. copper	
	Phytophthora	18 - 31	0.02 – 0.034 lbs. chitosan and 0.086 – 0.15 lbs. copper	
Rose	*See Flowering Potted Crops for Rates*			
Ruscus	Pseudomonas	11 - 22	0.012 – 0.024 lbs. chitosan and 0.053 – 0.106 lbs. copper	
Sycamore	Anthracnose	31	0.034 lbs. chitosan and 0.15 lbs. copper	
	Botrytis	11 -22	0.012 – 0.024 lbs. chitosan and 0.053 – 0.106 lbs. copper	
Viburnum	Botrytis	11 - 22		
	Cercospora	13 - 22	0.014 – 0.024 lbs. chitosan and 0.062 – 0.106 lbs. copper	
	Phytophthora	18 - 22	0.02 – 0.024 lbs. chitosan and 0.086 – 0.106 lbs. copper	
<u>Shrubs/Vines:</u> Barberry, Bougainvillea, Clematis Cornus, Cotinus, Forsythia, Gardenia, Holly, Paeonia, Philadelphus, Physocarpus, Potentilla, Ribes, Rosa, Spirea, Weigela <u>Deciduous:</u> Acer, Amelanchier, Betula, Celtis, Cercis, Cratageus, Ficus, Fraxinum, Ginkgo, Gelditisia, Magnolia, Malus, Populus, Prunus, Pyrus, Tilia <u>Conifers:</u> Abies, Juniper, Picea, Pinus, Pittosporum, Pseudotsuga, Taxus, Thuja, Tsuga <u>Non-Bearing Fruit Trees & Vines:</u> Apple, Pear, Grape, Citrus	Botrytis	11 - 22	0.012 – 0.024 lbs. chitosan and 0.053 – 0.106 lbs. copper	
	Fireblight	18 - 35	0.02 – 0.039 lbs. chitosan and 0.086 – 0.125 lbs. copper	
	Powdery Mildew	18 - 22	0.02 – 0.024 lbs. chitosan and 0.086 – 0.106 lbs. copper	
	Pseudomonas	13 - 31	0.014 – 0.034 lbs. chitosan and 0.062 – 0.149 lbs. copper	
	Rhizoctonia	11 - 22	0.012 – 0.024 lbs. chitosan and 0.053 – 0.106 lbs. copper	

Cut Flower Crops

Crop	Disease	Use Rate in fl. oz. per 100 gallons	Lbs. A.I./100 Gallons	Minimum Retreatment Interval
Alstromeria	Botrytis	11 - 13	0.012 – 0.014 lbs. chitosan and 0.053 – 0.062 lbs. copper	7 days
Carnation	Botrytis	11 - 18	0.012 – 0.02 lbs. chitosan and 0.053 – 0.086 lbs. copper	
Chrysanthemum	Botrytis	13 - 22	0.014 – 0.024 lbs. chitosan and 0.062 – 0.106 lbs. copper	
Delphinium	Botrytis	11 - 13	0.012 – 0.014 lbs. chitosan and 0.053 – 0.062 lbs. copper	
Freesia	Botrytis	11 - 13		
Gerbera	Botrytis	13 - 22	0.014 – 0.024 lbs. chitosan and 0.062 – 0.106 lbs. copper	
Gladiola	Botrytis	11 - 13	0.012 – 0.014 lbs. chitosan and 0.053 – 0.062 lbs. copper	
Lisianthus	Botrytis	11 - 18	0.012 – 0.02 lbs. chitosan and 0.053 – 0.086 lbs. copper	
Orchid	Botrytis	11 - 15	0.012 – 0.017 lbs. chitosan and 0.053 – 0.072 lbs. copper	
Rose	Botrytis	13 - 44	0.014 – 0.048 lbs. chitosan and 0.062 – 0.21 lbs. copper	
Snapdragon	Botrytis	11 - 18	0.012 – 0.02 lbs. chitosan and 0.053 – 0.086 lbs. copper	
Sweetpea	Botrytis	11 - 13	0.012 – 0.014 lbs. chitosan and 0.053 – 0.062 lbs. copper	

Tropical Foliage Crops

Crop	Disease	Use Rate in fl. oz. per 100 gallons	Lbs. A.I./100 Gallons	Minimum Retreatment Interval
Dracaena	Rust	13 – 22	0.014 – 0.024 lbs. chitosan and 0.062 – 0.106 lbs. copper	7 days
Ferns	Botrytis	11 – 18	0.012 – 0.02 lbs. chitosan and 0.053 – 0.086 lbs. copper	
	Erwinia	11 – 18		
Hibiscus	Botrytis	11 – 22	0.012 – 0.024 lbs. chitosan and 0.053 – 0.106 lbs. copper	
	Pseudomonas	13 – 22	0.014 – 0.024 lbs. chitosan and 0.062 – 0.106 lbs. copper	
	Xanthomonas	13 – 22		
Ivy	Botrytis	11 – 18	0.012 – 0.02 lbs. chitosan and 0.053 – 0.086 lbs. copper	
	Xanthomonas	13 – 44	0.014 – 0.048 lbs. chitosan and 0.062 – 0.21 lbs. copper	
Palms	Botrytis	11 – 18	0.012 – 0.02 lbs. chitosan and 0.053 – 0.086 lbs. copper	
	Erwinia	11 – 18		
	Pseudomonas	11 – 22	0.012 – 0.024 lbs. chitosan and 0.053 – 0.106 lbs. copper	
	Xanthomonas	11 – 22		
Spathiphyllum	Botrytis	11 – 22		
	Cylindrocladium	13 – 22	0.014 – 0.024 lbs. chitosan and 0.062 – 0.106 lbs. copper	
	Phytophthora	13 – 26	0.014 – 0.029 lbs. chitosan and 0.062 – 0.125 lbs. copper	
Tropical Foliage (General)	Botrytis	11 – 22	0.012 – 0.024 lbs. chitosan and 0.053 – 0.106 lbs. copper	
	Powdery Mildew	11 – 22		
	Erwinia	18 – 44	0.02 – 0.048 lbs. chitosan and 0.086 – 0.21 lbs. copper	
	Pseudomonas	18 – 44		
	Xanthomonas	18 – 44		

Specific Directions for Spray and Dip Applications During Propagation

When harvesting cuttings on site, spray or fog stock plants 1 to 2 days prior to taking cuttings. Spray cuttings to drench again at the same rate 2 to 3 days after sticking in rooting media, or dip cuttings for a few seconds prior to sticking.

When using rooted, callused, or unrooted cuttings shipped in, spray cuttings to drench 2 to 3 days after planting or sticking, or dip cuttings for a few seconds prior to sticking. Under severe disease pressure repeat in 7 to 10 days.

Herbaceous & Woody Stock Plants and Cuttings

Crop	Disease	Use Rate in fl. oz. per 100 gallons	Lbs. A.I./100 Gallons	Minimum Retreatment Interval
Azalea	Botrytis	11 – 22	0.012 – 0.024 lbs. chitosan and 0.053 – 0.106 lbs. copper	7 days
	Cylindrocladium	13 – 31	0.014 – 0.034 lbs. chitosan and 0.062 – 0.149 lbs. copper	
Chrysanthemum	Botrytis	13 – 22	0.014 – 0.024 lbs. chitosan and 0.062 – 0.106 lbs. copper	
	Erwinia	13 – 22		
Geranium	Botrytis	13 – 18	0.014 – 0.02 lbs. chitosan and 0.062 – 0.086 lbs. copper	
	Xanthomonas	13 – 44	0.014 – 0.048 lbs. chitosan and 0.062 – 0.21 lbs. copper	
Holiday Cactus	Botrytis	11 – 22	0.012 – 0.024 lbs. chitosan and 0.053 – 0.106 lbs. copper	
	Erwinia	13 – 18	0.014 – 0.02 lbs. chitosan and 0.062 – 0.086 lbs. copper	
Hydrangea	Botrytis	11 – 22	0.012 – 0.024 lbs. chitosan and 0.053 – 0.106 lbs. copper	
	Xanthomonas	13 – 22	0.014 – 0.024 lbs. chitosan and 0.062 – 0.106 lbs. copper	
Lavender	Botrytis	11 – 18	0.012 – 0.02 lbs. chitosan and 0.053 – 0.086 lbs. copper	
Mini-Rose	Botrytis	13 – 18	0.014 – 0.02 lbs. chitosan and 0.062 – 0.086 lbs. copper	
	Cylindrocladium	13 – 44	0.014 – 0.048 lbs. chitosan and 0.062 – 0.21 lbs. copper	
Poinsettia	Botrytis	13 – 18	0.014 – 0.02 lbs. chitosan and 0.062 – 0.086 lbs. copper	
	Erwinia	18 – 31	0.02 – 0.034 lbs. chitosan and 0.086 – 0.15 lbs. copper	
	Scab	18 – 31		
	Xanthomonas	18 – 31		
Tropical Foliage	Botrytis	11 – 22	0.012 – 0.024 lbs. chitosan and 0.053 – 0.106 lbs. copper	
	Cylindrocladium	13 – 22	0.014 – 0.024 lbs. chitosan and 0.062 – 0.106 lbs. copper	
	Erwinia	18 – 44	0.02 – 0.048 lbs. chitosan and 0.086 – 0.21 lbs. copper	

Post-Harvest Dip Applications on Cut Flower Crops

Crop	Disease	Use Rate in Teaspoons/5 gal	Application Instructions
Alstromeria	Botrytis	0.75 – 1	Dip cut flowers/buds for a few seconds soon after cutting
Carnation	Botrytis	2 – 3	
Chrysanthemum	Botrytis	2 – 3	
Delphinium	Botrytis	1 – 2	
Freesia	Botrytis	0.75 – 1	
Gerbera	Botrytis	2 – 3	
Gladiola	Botrytis	1.5 – 3	
Orchid	Botrytis	2 – 3	
Rose	Botrytis	3 – 3.75	
Snapdragon	Botrytis	1 – 2	
Sweetpea	Botrytis	1 – 2	

Bulb Applications

Crop	Disease	Use Rate in fl.oz./100 gal	Application Instructions
Calla Lily	Erwinia	26	Dip bulbs for 5 minutes, or spray bulbs to drip then allow to dry before planting.

Soil Drench Applications – Greenhouse, Field, Landscape & Interior

Crop	Disease	Use Rate in fl.oz./100 gal	Lbs. A.I./100 Gallons	Minimum Retreatment Interval
African Violet	Phytophthora	11 - 18	0.012 – 0.02 lbs. chitosan and 0.053 – 0.086 lbs. copper	7 days
Aster	Phytophthora	18 - 26	0.02 – 0.029 lbs. chitosan and 0.086 – 0.125 lbs. copper	
Azalea	Cylindrocladium	18 – 31	0.02 – 0.034 lbs. chitosan and 0.086 – 0.15 lbs. copper	
	Rhizoctonia			
Calla Lily	Erwinia	13 – 26	0.014 – 0.029 lbs. chitosan and 0.062 – 0.125 lbs. copper	
Cyclamen	Erwinia	13	0.014 lbs. chitosan and 0.062 lbs. copper	
Ferns	Rhizoctonia	13 – 26	0.014 – 0.029 lbs. chitosan and 0.062 – 0.125 lbs. copper	
Geranium	Botrytis	18 – 31	0.02 – 0.034 lbs. chitosan and 0.086 – 0.15 lbs. copper	
Hosta	Erwinia	13 – 22	0.014 – 0.024 lbs. chitosan and 0.062 – 0.106 lbs. copper	
Impatiens	Phytophthora	18 – 31	0.02 – 0.034 lbs. chitosan and 0.086 – 0.15 lbs. copper	
Japanese Maple	Verticillium	22	0.024 lbs. chitosan and 0.106 lbs. copper	
Pansy	Phytophthora	13 – 22	0.014 – 0.024 lbs. chitosan and 0.062 – 0.106 lbs. copper	
	Pythium			
Periwinkle	Phytophthora	13 – 18	0.014 – 0.02 lbs. chitosan and 0.062 – 0.086 lbs. copper	
Pittosporum	Rhizoctonia	13 – 18		
Poinsettia	Phytophthora	13 – 22	0.014 – 0.024 lbs. chitosan and 0.062 – 0.106 lbs. copper	
	Rhizoctonia	18 – 31	0.02 – 0.034 lbs. chitosan and 0.086 – 0.15 lbs. copper	
Rhododendron	Rhizoctonia	18 – 31		
Rose	Black Spot	18 – 31		
	Cylindrocladium			
Spathiphyllum	Cylindrocladium	18 – 31		
	Phytophthora			
Vinca minor	Rhizoctonia	13 - 22	0.014 – 0.024 lbs. chitosan and 0.062 – 0.106 lbs. copper	

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.

Pesticide Storage: Store in a cool dry place. Avoid freezing.

Pesticide Disposal: To avoid wastes, use all material in this container by application according to label directions. If wastes cannot be avoided, offer remaining product to a waste disposal facility or pesticide disposal program (often such programs are run by state or local government or by industry).

Do not contaminate water when disposing of equipment wash water or rinsate. Pesticide wastes may be toxic. Improper disposal of unused pesticide, wash water or rinse water is a violation of federal law.

Container Handling: Nonrefillable Container (five gallons or less): Nonrefillable container. Do not reuse or refill this container. Offer for recycling, if available. Clean container 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 1/4 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 if available or reconditioning if appropriate or puncture and dispose of in a sanitary landfill or by other procedures approved by state and local authorities.

Nonrefillable Container (greater than five gallons): Nonrefillable container. Do not reuse or refill this container. Offer for recycling, if available. Clean container promptly after emptying. Triple rinse as follows: Empty the remaining contents into application equipment or a mix tank. Fill the container 1/4 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 more times. Then offer for recycling if available or reconditioning if appropriate or puncture and dispose of in a sanitary landfill or by other procedures approved by state and local authorities

Warranty Statement

Ag NuBio warrants that this product conforms to the chemical description on the label thereof and is reasonably fit for purposes stated on such label only when used in accordance with directions under normal use conditions. It is impossible to eliminate all risks inherently associated with use of this product. Crop injury, ineffectiveness or other unintended consequences may result because of such factors as weather conditions, presence of other materials or the manner of use or application, all of which are beyond the control of Ag NuBio. To the extent consistent with applicable law, Ag NuBio shall not be liable for consequential, special or indirect damages resulting from the use or handling of this product. All such risks shall be assumed by the Buyer. To the extent consistent with applicable law, the exclusive remedy of any buyer or user of this product for any and all losses, injuries, or damages resulting from or in any way arising from the use, handling, or application of this product, whether in contract, warranty, tort, negligence, strict liability, or otherwise, shall not exceed the purchase price paid for this product or at Ag NuBio election, the replacement of this product. Ag NuBio MAKES NO WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR ANY OTHER EXPRESS OR IMPLIED WARRANTY EXCEPT AS STATED ABOVE.

SUB-LABEL B: Consumer Label

DIRECTIONS FOR USE

It is a violation of federal law to use this product in a manner inconsistent with its labeling. 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. For any requirements specific to your state or tribe, consult the agency responsible for pesticide regulation. READ THE ENTIRE LABEL BEFORE USING THIS PRODUCT.

PRODUCT INFORMATION

BIOREND® Cu is a combination fungicide, bactericide and plant defense booster. Complete coverage is essential to assure good product performance.

The chitosan in BIOREND® Cu stimulates SAR (Systemic Acquired Resistance) mechanism, which allows plants to be less susceptible to bacterial and fungal diseases. BIOREND® Cu also allows the healing of wounds, to reduce the incidence of fungal and bacterial diseases.

When used as directed on this label BIOREND® Cu can enhance plant vigor, promote foliar growth, increase crop yields, improve crop vigor and quality, aid in suppression of diseases and pathogens, activate plant resistance to environmental stress, drought and disease pressure.

HOW TO APPLY

[For use when packaged as a concentrate for use in hose-end sprayers]

Shake well before use. Most conventional liquid pesticide plant sprayers can be used to apply BIOREND® Cu to plants. Mix 0.1 to 0.5 fluid ounces of BIOREND® Cu in a gallon of water. Unless otherwise stated in specific application notes, apply 1.1 to 2.3 gallons of diluted spray per 1,000 square ft**.** Choose rate level according to disease pressure using the higher rate when pressure is highest unless directed otherwise in the crop specific directions.

[For use when packaged with a hose-end attachment as part of the bottle]

Shake well before use. The hose-end sprayer automatically dilutes the product to control listed diseases at a rate of 1.1 to 2.3 gallons of diluted spray per 1,000 square feet.

WHEN TO APPLY

For best control, start spraying before the disease is visible or when disease is first visible on the plant. Spray all plant parts thoroughly (top and bottom of leaves), and unless otherwise directed in the crop table, repeat every 7 to 10 days. Use the higher rate to control diseases that may go dormant and overwinter. See application notes for the specific crop application interval. If possible, time applications so that at least 12 hours of dry weather follows application. Reapply after rain, following crop specific application interval.

When **powdery mildew** presence is expected on a plant, spray the plants at the minimum application interval during the first 2 weeks after emergence.

To control **downy mildews, leaf and fruit spots, blights, and rust**, begin treatment 2 weeks before disease normally appears or when weather forecasts predict a long period of wet weather. Alternatively, begin treatment when disease first appears, and repeat as long as needed.

To prevent **fruit rots**, apply at the start of flowering and unless otherwise directed in the crop table, repeat every 7 to 10 days until harvest. Fungicidal sprays are especially warranted when weather forecasts predict a long period of wet weather.

Ornamentals and Turf

Do not use more than 101 fl.oz. of product/1000 sq. ft. per year on turf or more than 96 fl. oz. of product/1000 sq. ft. per year on ornamentals. BIOREND® Cu may cause some copper toxicity on some plant species. Before spraying a specific plant species consult your State Experiment Station or make a test spray.

Crop	Diseases Controlled	Application Instructions
Rose and Ornamental Shrubs (Such as; Crape Myrtle, Forsythia, Hydrangea, Willow, Mock- Orange, Deutzia, Pyracantha, Japanese quince, Abelia, Summersweet)	Blackspot, Downy mildew, Gray mold (Botrytis), Leafspots, Powdery mildew, Rust	May cause copper toxicity on some rose varieties. Copper toxicity appears as purple spots. For Black spot, mix 0.4 fl. ozs. of BIOREND® Cu per gallon of water. For Powdery Mildew, mix 0.3 fl. ozs. of BIOREND® Cu per gallon of water. In damp cool conditions (below 60°F), phytotoxicity is likely to occur. [Language to use with hose-end sprayer: The hose end sprayer applies product within the rates above.]
Shrubs/Vines (such as): Barberry, Bougainvillea, Clematis Cornus, Cotinus, Forsythia, Gardenia, Holly, Paeonia, Philadelphus, Physocarpus, Potentilla, Ribes, Rosa, Spirea, Weigela	Downy mildew, Gray mold (Botrytis), Leafspots, Powdery mildew, Rust	Apply BIOREND® Cu when disease first appears. For Powdery Mildew, mix 0.3 fl. ozs. of BIOREND® Cu per gallon of water. In damp cool conditions (below 60°F), phytotoxicity is likely to occur. [Language to use with hose-end sprayer: The hose end sprayer applies product within the rates above.]
Fir, Juniper, Pine, Pittosporum	Gray mold (Botrytis), Powdery mildew, Needle Blight	Spray until needles are thoroughly wet with spray. Apply when new needles are just emerging.
Sycamore	Anthracnose leaf spot	Make first application just before buds begin to swell, and repeat twice, at 7-day intervals.
Turf	Ascochyta leaf blight, Cercospora leaf spots, Dollar spot	Mix 0.4 to 1.5 fl. oz. with 2.5 gallons of water and apply to 1,000 sq. ft. For best control, begin treatment 2 weeks before disease normally appears. Alternatively, begin treatment when disease first appears, and repeat at 10 day intervals for as long as needed. To reduce Ascochyta leaf blight mow less frequently, only as necessary to maintain recommended height. Water before noon to allow grass to dry. Water thoroughly only as required to avoid moisture stress. Apply BIOREND® Cu when disease first appears, and repeat at 10 day intervals for as long as needed. In frequently diseased areas, prune adjacent trees and shrubs to reduce turf shading and to improve air movement. [Language to use with hose end sprayer: The hose end sprayer applies product within the rates above.]
	Rust	To reduce rust mow frequently to reduce rust spore production. Water and fertilize lawn as required to avoid moisture and nutrient stress. Water before noon to allow grass to dry. Apply BIOREND® Cu when disease first appears, and repeat at 10 day intervals for as long as needed. In frequently diseased areas, prune adjacent trees and shrubs to reduce turf shading and to improve air movement.
	Algae	For best control, begin treatment 2 weeks before disease normally appears. Alternatively, begin treatment when disease first appears, and repeat at 10 day intervals for as long as needed.

Crop	Diseases Controlled	Application Instructions
Non-Bearing Fruit Trees & Vines (including): Apple, Pear, Grape, Citrus	Blackspot, Downy mildew, Gray mold (Botrytis), Leafspots, Powdery mildew, Rust	Apply as a full cover spray for early season disease suppression.

Fruits and Vegetables

Crop	Disease	Maximum Annual Rate in fl. oz. per 1,000 ft^2	Minimum Retreatment Interval	Application Instructions
Corn	Bacterial Stalk Rot	85	7 days	Begin treatment when disease first appears and every 7 to 10 days or as needed. Use shorter spray intervals when conditions favor disease.
Strawberry	Angular Leaf Spot (Xanthomonas) Leaf Blight, Leaf Scorch, Leaf Spot	309	7 days	Begin application when plants are established and continue on a weekly schedule throughout the season. NOTE: Discontinue applications if signs of crop injury appear.
Bean (Dry, Green)	Brown Spot, Common Blight, Halo Blight	211	7 days	For protective sprays, make first application when plants are 6 inches high; repeat on a 7 to 14 day schedule or as needed depending on environmental conditions. Use the higher rates for more severe disease.
Beet (Table Beet, Beet Greens)	Cercospora Leaf Spot	85	10 days	Begin applications when conditions first favor disease development and repeat at 10 to 14 day intervals or as needed. Use higher rates when conditions favor disease.
Carrot	Alternaria Leaf Spot, Cercospora Leaf Spot	211	7 days	Begin applications when disease first threatens and repeat at 7 to 14 day intervals or as needed depending on disease severity.
Celery, Celeriac	Bacterial Blight, Cercospora Early Blight, Septoria Late Blight	85	7 days	Begin applications as soon as plants are first established in the field, repeating at 5 to 7 day intervals or as needed depending on disease severity and environmental conditions.
Crucifers (Broccoli, Brussels Sprouts, Cabbage, Cauliflower, Collard Greens, Mustard Greens, Turnip Greens)	Black Leaf Spot (*Alternaria*) Black Rot (*Xanthomonas*) Downy Mildew	85	7 days	Begin application after transplanting or shortly after emergence of seeds or when conditions favor disease development. Apply at 7 to 10 day intervals or as needed. Use the higher rates when conditions favor disease. NOTE: Reddening of older leaves may occur on broccoli and a flecking of wrapper leaves may occur on cabbage.
Cucurbits (Cantaloupe, Cucumber, Honeydew, Muskmelon, Pumpkin, Squash, Watermelon)	Alternaria Leaf Spot, Angular Leaf Spot, Anthracnose, Downy Mildew, Gummy Stem Blight, Powdery Mildew, Watermelon Bacterial Fruit Blotch (suppression)	211	5 days	Begin applications prior to disease development and continue while conditions are favorable for disease development. Repeat at 5 to 7 day intervals or as needed. Use the higher rates when conditions favor disease. NOTE: Crop injury may occur from application at higher rates and shorter intervals. Discontinue use if injury occurs.
Eggplant	Alternaria Blight, Anthracnose Phomopsis	126	7 days	Begin applications prior to development of disease symptoms. Repeat spray at 7 to 10 day intervals or as needed depending on disease severity.

Crop	Disease	Maximum Annual Rate in fl. oz. per 1,000 ft²	Minimum Retreatment Interval	Application Instructions
Grapes	Block Rot, Downy Mildew, Phomopis, Powdery Mildew	421	3 days	Begin applications at bud break with subsequent applications throughout the season depending on disease severity. Use the higher rates when conditions favor disease. NOTE: Foliage injury may occur on copper sensitive varieties such as Concord, Delaware, Niagara and Rosette.
Okra	Anthracnose, Bacterial Leaf Spot,Leaf Spots, Pod Spot, Powdery Mildew	126	5 days	Begin treatment when disease first threatens and repeat every 5 to 10 days or as needed depending on disease severity. Use the higher rates and shorter spray intervals when conditions favor disease.
Onion, Garlic	Bacterial Blight, Downy Mildew, Purple Blotch	211	7 days	Begin when plants are 4 to 6 inches high and repeat at 7 to 10 day intervals or as needed depending on disease severity. Can cause phytotoxicity to leaves.
Pea	Powdery Mildew	98	7 days	Begin applications when disease symptoms first appear and repeat at weekly intervals or as needed. Use the higher rates when conditions favor disease.
Pepper	Anthracnose, Bacterial Spot, Cercospora Leaf Spot	421	3 days	Begin applications when condition first favor disease development and repeat at 7 to 10 day intervals or as needed depending on disease severity. Use the higher rates when conditions favor disease.
Spinach	Anthracnose, Blue Mold, Cercospora Leaf Spot, White Rust	70	7 days	Begin application when disease first appears or when conditions favor disease development. Repeat at 7 to 10 day intervals or as needed. Use the higher rates when conditions favor disease. NOTE: Flecking may occur in spinach leaves
Tomato	Anthracnose, Bacterial Speck, Bacterial Spot, Early Blight Gray Leaf Mold, Late Blight, Septoria Leaf Spot	562	3 days	Begin applications when disease first threatens and repeat at 5 to 10 day intervals or as needed depending on disease severity. Use the higher rates when conditions favor disease.

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.

Pesticide Storage: Store in a cool dry place. Avoid freezing. Store in a locked area away from children and domestic animals.

Pesticide Disposal and Container Handling: Non-refillable container. Do not reuse or refill this container. **If empty**: Place in trash or offer for recycling if available. **If partly filled:** Call your local solid waste agency for disposal instructions. Never place unused product down any indoor (including toilet) or outdoor (including sewer) drain.

Warranty Statement

Ag NuBio warrants that this product conforms to the chemical description on the label thereof and is reasonably fit for purposes stated on such label only when used in accordance with directions under normal use conditions. It is impossible to eliminate all risks inherently associated with use of this product. Crop injury, ineffectiveness or other unintended consequences may result because of such factors as weather conditions, presence of other materials or the manner of use or application, all of which are beyond the control of Ag NuBio. To the extent consistent with applicable law, Ag NuBio shall not be liable for consequential, special or indirect damages resulting from the use or handling of this product. All such risks shall be assumed by the Buyer. To the extent consistent with applicable law, the exclusive remedy of any buyer or user of this product for any and all losses,

injuries, or damages resulting from or in any way arising from the use, handling, or application of this product, whether in contract, warranty, tort, negligence, strict liability, or otherwise, shall not exceed the purchase price paid for this product or at Ag NuBio election, the replacement of this product. Ag NuBio MAKES NO WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR ANY OTHER EXPRESS OR IMPLIED WARRANTY EXCEPT AS STATED ABOVE.

Optional Marketing Claims – Applicable to both sub-labels (unless otherwise noted):

- This container will treat 32,000 to 160,000 square feet [use for 16 fl.oz. container – Sub-Label B]
- This container will treat up to 160,000 square feet [use for 16 fl.oz. container – Sub-Label B]
- This container will treat 16,000 to 80,000 square feet [use for 8 fl.oz. container – Sub-Label B]
- This container will treat up to 80,000 square feet [use for 8 fl.oz. container – Sub-Label B]
- For Roses, Listed Fruits and/& Listed Vegetables
- Controls Powdery Mildew, Black Spot & Rust
- Controls diseases that may go dormant overwinter
- Contains chitosan which boosts plant health
- Lawn fungicide
- Dormant and growing season liquid copper fungicide
- Contains chitosan which supports plants to defend for themselves against pathogens and disease
- Triggers defensive mechanisms in plants for better production
- Activates innate immunity

OFFICE OF CHEMICAL SAFETY AND POLLUTION PREVENTION
WASHINGTON, D.C. 20460

March 20, 2025

Jeremy Malone
jeremy@springregulatory.com
VISJON BIOLOGICS

Subject: Non-PRIA (Pesticide Registration Improvement Act) Labeling Amendment - Revision to the label including addition of an additional use and addition of two sublabels.
Product Name: Exceed SAR Plus
Admin Number: 91967-1
EPA Receipt Date: 10/04/2024
Action Case Number: 00637622

Dear Jeremy Malone:

The amended labeling referred to above, submitted in connection with registration under the Federal Insecticide, Fungicide, and Rodenticide Act, as amended, is acceptable.

This approval does not affect any terms or conditions that were previously imposed on this registration. You continue to be subject to existing terms or conditions on your registration and any deadlines connected with them.

The supplemental labeling contains some new and/or revised uses and/or directions that may be additional to the uses and/or directions found on the label on or attached to the container, but the supplemental labeling does not by itself constitute the complete set of use directions. The complete set of use directions is set forth on the container label as combined with the supplemental labeling.

A stamped copy of your labeling is enclosed for your records. This labeling supersedes all previously accepted labeling. You must submit one (1) copy of the final printed labeling before you release this product for shipment with the new labeling. In accordance with 40 CFR § 152.130(c), you may distribute or sell this product under the previously approved labeling for 18 months from the date of this letter. After 18 months, you may only distribute or sell this product if it bears this new revised labeling or subsequently approved labeling. “To distribute or sell” is defined under FIFRA section 2(gg) and its implementing regulation at 40 CFR § 152.3.

Should you wish to add/retain a reference to your company’s website on your label, then please be aware that the website becomes labeling under FIFRA and is subject to review by EPA. If the website is false or misleading, the product will be considered to be misbranded and sale or distribution of the product is unlawful under FIFRA section 12(a)(1)(E). 40 CFR § 156.10(a)(5) lists examples of statements the EPA may consider false or misleading. In addition, regardless of whether a website is referenced on your product’s label, claims made on the website may not substantially differ from those claims approved through the registration process. Therefore, should the EPA find or if it is brought to our attention that a website contains statements or claims substantially differing from statements or claims made in connection with obtaining a FIFRA section 3 registration, the website will be referred to the EPA’s Office of Enforcement and Compliance Assurance.

Your release for shipment of this product constitutes acceptance of these terms. If these terms are not complied with, this registration will be subject to cancellation in accordance with FIFRA section 6.

If you have questions, please contact Leslie Paul via email at paul.leslie@epa.gov.

Sincerely,

James Parker, Team Leader
BPB, BPPD
Office of Pesticide Programs

ACCEPTED
Mar 20, 2025
Under the Federal Insecticide, Fungicide and Rodenticide Act as amended, for the pesticide registered under EPA Reg. No. 91967-1

[Denotes Optional Text]
{Denotes Notes to EPA Reviewer}
{Label version date 20250314}

Sublabel A: Base label
Sublabel B: Base pesticide label and copackaged inoculate label for use with soybeans
Sublabel C: Base pesticide label and copackaged inoculate label for use with garbanzo beans

EXCEED® SAR PLUS

Seed Treatment

{Alternate Name Brand: EXCEED® SAR PLANT DEFENSE BOOSTER PLUS}

When used as directed on this label, EXCEED™ SAR PLUS can boost seed germination and vitality, stimulate emergence and sprouting, enhance plant vigor, promote root growth, promote foliar growth, increase crop yields, improve crop vigor and quality, suppress diseases and pathogens, activate plant resistances to environment stress, drought, and disease pressures, including the suppression of parasitic nematodes.

Active Ingredient:

Chitosan .....,	0.05%
Other Ingredients	99.95%
Total	100.00%

Product contains 0.004 lbs. of chitosan/gallon.

KEEP OUT OF THE REACH OF CHILDREN

CAUTION

{Sublabel A: Base label}

EXCEED® SAR PLUS

Seed Treatment

When used as directed on this label, EXCEED™ SAR PLUS can boost seed germination and vitality, stimulate emergence and sprouting, enhance plant vigor, promote root growth, promote foliar growth, increase crop yields, improve crop vigor and quality, suppress diseases and pathogens, activate plant resistances to environment stress, drought, and disease pressures, including the suppression of parasitic nematodes.

Active Ingredient:

Chitosan .....,	0.05%
Other Ingredients	99.95%
Total	100.00%

Product contains 0.004 lbs. of chitosan/gallon.

KEEP OUT OF THE REACH OF CHILDREN

CAUTION

FIRST AID	
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 treatment advice.
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 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. You may also contact 1-800-222-1222 for emergency medical treatment information.	

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION: Causes moderate eye irritation. Avoid contact with eyes. Wash thoroughly with soap and water after handling.

ENVIRONMENTAL HAZARDS

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 cleaning equipment or disposing of equipment wash waters.

{For containers 5 gallons or greater:} Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans or public 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 into sewers without previously notifying the sewage treatment plant authority. For guidance, contact your State Water board or regional Office of the EPA.

NET CONTENTS:
- ☐ 11.8 fl. oz. (0.35 L)
- ☐ 18.6 fl. oz. (0.55 L)
- ☐ 47.3 fl. oz. (1.4 L)
- ☐ 74.4 fl. oz. (2.2 L)
- ☐ 94.68 fl. oz. (2.8 L)

MANUFACTURED FOR:
Visjon Biologics
1092 S Graham ST.
Henrietta, TX 76365

EPA Registration No.: 91967-1
EPA Establishment No.: _____
Lot/Batch Code: _____

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Applicators and other handlers must wear: Long-sleeved shirt, long pants, waterproof gloves, protective eyewear, and shoes plus socks. Follow manufacturer's instructions for cleaning/maintaining PPE separately from other laundry.

DIRECTIONS FOR USE

It is a violation of federal laws to use this product in a manner inconsistent with its labeling.

To prevent contamination of the dilute solutions of EXCEED™ SAR PLUS by possible pesticide or other chemical residues in the spraying equipment, use dedicated equipment, or be sure that the equipment is thoroughly clean before use.

For Agricultural Use:
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. For any requirements specific to your State or Tribe, consult the agency responsible for pesticide regulation.

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 interval. 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.

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
- Waterproof gloves
- Protective eyewear, and
- Shoes plus socks

GENERAL INSTRUCTIONS

Shake before using. Following specific crop instructions for dilution rates and application usage. Do not apply within three days of harvesting. For best results use pH neutral (pH 6.9 to 7.0) mix water.

Crop	Mixing and Application Instructions
Garbanzo Bean	For seed treatment, apply 0.75 fluid ounces of product per 100 lbs. seed in conjunction with the inoculant product Exceed® SAR Custom Liquid for Garbanzo Bean. Apply as a water based slurry through standard slurry or mist-type commercial seed treatment equipment.
Soybeans	For seed treatment, apply 0.3 – 0.5 fluid ounces of product per 100 lbs. seed in conjunction with the inoculant product Exceed® SAR Custom Liquid for Soybeans with Cell Armor Technology. Apply as a water based slurry through standard slurry or mist-type commercial seed treatment equipment.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

PESTICIDE STORAGE: Store in original container in a cool, dry place away from sunlight and out of the reach of children and pets. Do not reuse container.

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: Nonrefillable container. Do not reuse or refill this container. Offer for recycling, if available. Triple rinse or pressure rinse container (or equivalent) promptly after emptying. {For product less than 5 gallons} 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 1/4 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. {For product greater than 5 gallons} Triple rinse as follows: Empty the remaining contents into application equipment or a mix tank. Fill the container 1/4 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 more times. An empty container retains vapor and product residue. Observe label safeguards until container is cleaned, reconditioned or destroyed. Completely empty contents into formulation equipment. Then offer for recycling or reconditioning or, dispose of container in a manner approved by state and local authorities.

WARRANTY

Visjon Biologics warrants that this product conforms to the chemical description on the label thereof and is reasonably fit for purposes stated on such label only when used in accordance with directions under normal use conditions. It is impossible to eliminate all risks inherently associated with use of this product. Crop injury, ineffectiveness or other unintended consequences may result because of such factors as weather conditions, the presence of other materials or the manner of use of application, all of which are beyond the control of Visjon Biologics. To the extent consistent with applicable law, Visjon Biologics shall not be liable for consequential, special or indirect damages resulting from the use or handling of this product. All such risks shall be assumed by the Buyer.

To the extent consistent with applicable law, the exclusive remedy of any buyer or use of this product for any and all losses, injuries, or damages resulting from or in any way arising from the use, handling, or application of the product, whether in contract, warranty, tort, negligence, strict liability, or otherwise, shall not exceed the purchase price paid for this product or at Visjon Biologics' election, the replacement of this product. Visjon Biologics MAKES NO WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PUROSE OR ANY OTHER EXPRESS OR IMPLIED WARRANTY EXCEPT AS STATED ABOVE.

{Sublabel B: Base pesticide label and copackaged inoculate label for use with soybeans}

EXCEED® SAR PLUS

Seed Treatment

When used as directed on this label, EXCEED™ SAR PLUS can boost seed germination and vitality, stimulate emergence and sprouting, enhance plant vigor, promote root growth, promote foliar growth, increase crop yields, improve crop vigor and quality, suppress diseases and pathogens, activate plant resistances to environment stress, drought, and disease pressures, including the suppression of parasitic nematodes.

For use on soybeans in conjunction with Exceed® SAR Custom Liquid for Soybean with Cell Armor Technology

Active Ingredient:

Chitosan	0.05%
Other Ingredients	99.95%
Total	100.00%

Product contains 0.004 lbs. of chitosan/gallon.

KEEP OUT OF THE REACH OF CHILDREN

CAUTION

FIRST AID	
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 treatment advice.
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 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. You may also contact 1-800-222-1222 for emergency medical treatment information.	

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION: Causes moderate eye irritation. Avoid contact with eyes. Wash thoroughly with soap and water after handling.

ENVIRONMENTAL HAZARDS

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 cleaning equipment or disposing of equipment wash waters.

{For containers 5 gallons or greater:} Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans or public 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 into sewers without previously notifying the sewage treatment plant authority. For guidance, contact your State Water board or regional Office of the EPA.

NET CONTENTS:
- ☐ 11.8 fl. oz. (0.35 L)
- ☐ 18.6 fl. oz. (0.55 L)
- ☐ 47.3 fl. oz. (1.4 L)
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MANUFACTURED FOR:
Visjon Biologics
1092 S Graham ST.
Henrietta, TX 76365

EPA Registration No.: 91967-1
EPA Establishment No.: _____
Lot/Batch Code: _____

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Applicators and other handlers must wear: Long-sleeved shirt, long pants, waterproof gloves, protective eyewear, and shoes plus socks. Follow manufacturer's instructions for cleaning/maintaining PPE separately from other laundry.

DIRECTIONS FOR USE

It is a violation of federal laws to use this product in a manner inconsistent with its labeling.

To prevent contamination of the dilute solutions of EXCEED™ SAR PLUS by possible pesticide or other chemical residues in the spraying equipment, use dedicated equipment, or be sure that the equipment is thoroughly clean before use.

For Agricultural Use:

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. For any requirements specific to your State or Tribe, consult the agency responsible for pesticide regulation.

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 interval. 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.

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
- Waterproof gloves
- Protective eyewear, and
- Shoes plus socks

GENERAL INSTRUCTIONS

Shake before using. Following specific crop instructions for dilution rates and application usage. Do not apply within three days of harvesting. For best results use pH neutral (pH 6.9 to 7.0) mix water.

Crop	Mixing and Application Instructions
Soybeans	For seed treatment, apply 0.3 – 0.5 fluid ounces of product per 100 lbs. seed in conjunction with the inoculant product Exceed® SAR Custom Liquid for Soybeans with Cell Armor Technology. Apply as a water based slurry through standard slurry or mist-type commercial seed treatment equipment.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

PESTICIDE STORAGE: Store in original container in a cool, dry place away from sunlight and out of the reach of children and pets. Do not reuse container.

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: Nonrefillable container. Do not reuse or refill this container. Offer for recycling, if available. Triple rinse or pressure rinse container (or equivalent) promptly after emptying. {For product less than 5 gallons} 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 1/4 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. {For product greater than 5 gallons} Triple rinse as follows: Empty the remaining contents into application equipment or a mix tank. Fill the container 1/4 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 more times. An empty container retains vapor and product residue. Observe label safeguards until container is cleaned, reconditioned or destroyed. Completely empty contents into formulation equipment. Then offer for recycling or reconditioning or, dispose of container in a manner approved by state and local authorities.

WARRANTY

Visjon Biologics warrants that this product conforms to the chemical description on the label thereof and is reasonably fit for purposes stated on such label only when used in accordance with directions under normal use conditions. It is impossible to eliminate all risks inherently associated with use of this product. Crop injury, ineffectiveness or other unintended consequences may result because of such factors as weather conditions, the presence of other materials or the manner of use of application, all of which are beyond the control of Visjon Biologics. To the extent consistent with applicable law, Visjon Biologics shall not be liable for consequential, special or indirect damages resulting from the use or handling of this product. All such risks shall be assumed by the Buyer.

To the extent consistent with applicable law, the exclusive remedy of any buyer or use of this product for any and all losses, injuries, or damages resulting from or in any way arising from the use, handling, or application of the product, whether in contract, warranty, tort, negligence, strict liability, or otherwise, shall not exceed the purchase price paid for this product or at Visjon Biologics' election, the replacement of this product. Visjon Biologics MAKES NO WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PUROSE OR ANY OTHER EXPRESS OR IMPLIED WARRANTY EXCEPT AS STATED ABOVE.

{Co-Packaged Product Labeling – This product can be co-packaged with the Exceed® SAR Custom Liquid for Soybeans seed inoculant product}

EXCEED® SAR CUSTOM LIQUID FOR SOYBEAN WITH CELL ARMOR TECHNOLOGY

This liquid inoculant is intended to be applied on-seed. It is a culture of highly effective strain of rhizobia (nitrogen-fixing bacteria) that will colonize the plant roots to gather and fix the "free" nitrogen of the air, making it available to the plants. The Cell Armor Technology in this inoculant thickens the rhizobium cell wall allowing osmotic balance by accumulating osmolytes in the cytoplasm. This prevents water inside the cell from moving outside, assists with protection from damage due to drought and salinity, and improves nutrient acquisition.

Treats: 25,000# (11,340 kg) of seed or 500 units - Product 1017
Net Contents: One 12.0 L (405.77 fl oz) Bladder bag of inoculant with Cell Armor Technology and One 2.8 L (94.68 fl oz) Bladder bag of Exceed® SAR Plant Defense Booster Plus
Package Configuration: One package containing one inoculant bladder bag and one Exceed® SAR Plant Defense Booster Plus bladder bag, 42 cases/ pallet

Treats: 12,500# (5,670 kg) of seed or 250 units - Product 1001
Net Contents: One 6.0 L (202.7 fl oz) Bladder bag of inoculant with Cell Armor Technology and One 1.4 L (47.3 fl oz) Bladder bag of Exceed® SAR Plant Defense Booster Plus
Package Configuration: 2 packages, each containing one inoculant bladder bag and one Exceed® SAR Plant Defense Booster Plus bladder bag, 54 cases/pallet

Treats: 2,500# (1,134 kg) of seed or 50 units - Product 1002
Net Contents: One 1.15 L (38.8 fl oz) Bladder bag of inoculant with Cell Armor Technology and One 0.35 L (11.8 fl oz) Bladder bag of Exceed® SAR Plant Defense Booster Plus
Package Configuration: 4 packages, each containing one inoculant bladder bag and one Exceed® SAR Plant Defense Booster Plus bladder bag, 54 cases/pallet

CONTAINS NONPLANT FOOD INGREDIENTS
Minimum Guaranteed Analysis
Inoculant:
Active Ingredient: <1% by Weight
Bradyrhizobium japonicum: 1x 10^{10} CFU/mL
Inactive Ingredients: >99% by Weight

KEEP OUT OF REACH OF CHILDREN
This product does not meet the regulatory definition of a hazardous chemical under 29 CFR 1910.1200. However, good industrial hygiene practices should be used in the manufacture and handling of the product.

Precautionary Information:
While Exceed® SAR Custom Liquid for Soybean with Cell Armor Technology is non-toxic it is recommended that the applicator avoid inhalation. Visjon Biologics recommends the use of gloves and eye protection while using Exceed® SAR Custom Liquid for Soybean with Cell Armor Technology.

This product is designed to be custom applied through an approved application device by a retail location that has been trained in the proper methods of handling and applying Exceed® SAR Custom Liquid to soybean seed. Please read all directions and specifications carefully before using this product. This product contains live organisms that are sensitive to chemicals and harsh environmental conditions.

FOR RETAIL APPLICATION ONLY.
Directions for Application:
• Ensure that the treater has been properly calibrated.
• Shake each container well before use.
• Pour each container into mix tank.
• Agitate or recirculate liquid mixture to ensure proper distribution of bacteria and Exceed® SAR Plus.
• Apply at a rate of 2.0 fl oz (60 mL) per cwt or 1.0 fl oz (30 mL) per 140,000 seeds.
Application rates are based upon 2,800 seeds per pound (0.45 kg).
• Prepare only as much Exceed® SAR Custom Liquid for Soybean with Cell Armor Technology as will be used that day.
• Consult with a Visjon Biologics representative for a complete list of compatible seed treatments.
The product density of Exceed® SAR Custom Liquid for Soybean with Cell Armor Technology is 8.6 lbs/gal (1.03 g/mL).

Storage of Exceed ® SAR Custom Liquid for Soybean with Cell Armor Technology:
• Always read and follow instructions.
• Store in a cool, dry place out of direct sunlight.
• Store product between 40º and 77º F (4º and 25º C.)
• Open package only when ready to use.
• Use before expiration date.
• Do not store in an area which is to be fumigated.
• Small amounts of product which cannot be used according to instructions may be disposed of in a landfill.

Expiration Date:
Exceed® SAR Custom Liquid for Soybean with Cell Armor Technology carries a one-season shelf life and expires the date stamped on the case.

Information regarding the contents and levels of metals in this product is available on the internet at: http://www.aapfco.org/metals.html

Limited Warranty:
VISJON BIOLOGICS GUARANTEES THIS CULTURE TO PRODUCE SATISFACTORY NODULE FORMATION AND NITROGEN FIXATION UNDER FAVORABLE CONDITIONS OF SOIL AND CLIMATE WHEN USED BEFORE EXPIRATION DATE AND APPLIED UNDER THE MANUFACTURER'S SPECIFICATIONS, OR PURCHASE PRICE WILL BE REFUNDED. A VISJON BIOLOGICS REPRESENTATIVE MUST BE NOTIFIED OF ANY FIELD COMPLAINT WITHIN FIFTY (50) DAYS AFTER PLANTING. MANY FACTORS OTHER THAN NODULATION AFFECT CROP PERFORMANCE. VISJON BIOLOGICS ASSUMES NO RESPONSIBILITY FOR LOSS OR PARTIAL LOSS OF CROP FROM ANY CAUSE WHATSOEVER. THIS LIMITED WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED. THE LIMITED WARRANTY IS VOID WHERE PROHIBITED BY LAW. IF YOU

HAVE ANY QUESTIONS ABOUT THIS PRODUCT OR ANY OTHER VISJON BIOLOGICS PRODUCT, CALL 940-264-0343 FOR ASSISTANCE.

Visjon Biologics
1092 S Graham ST
Henrietta TX 76365
940-264-0343 | 940-264-0344 fax
www.visjonbiologics.com
Exceed® is a registered trademark of Visjon Biologics.

{Sublabel C: Base pesticide label and copackaged inoculate label for use with garbanzo beans}

EXCEED® SAR PLUS

Seed Treatment

When used as directed on this label, EXCEED™ SAR PLUS can boost seed germination and vitality, stimulate emergence and sprouting, enhance plant vigor, promote root growth, promote foliar growth, increase crop yields, improve crop vigor and quality, suppress diseases and pathogens, activate plant resistances to environment stress, drought, and disease pressures, including the suppression of parasitic nematodes.

For use on garbanzo bean in conjunction with Exceed Custom Liquid for Garbanzo Bean.

Active Ingredient:

Chitosan	0.05%
Other Ingredients	99.95%
Total	100.00%

Product contains 0.004 lbs. of chitosan/gallon.

KEEP OUT OF THE REACH OF CHILDREN

CAUTION

FIRST AID	
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 treatment advice.
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 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. You may also contact 1-800-222-1222 for emergency medical treatment information.	

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION: Causes moderate eye irritation. Avoid contact with eyes. Wash thoroughly with soap and water after handling.

ENVIRONMENTAL HAZARDS

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 cleaning equipment or disposing of equipment wash waters.

{For containers 5 gallons or greater:} Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans or public 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 into sewers without previously notifying the sewage treatment plant authority. For guidance, contact your State Water board or regional Office of the EPA.

NET CONTENTS:
- ☐ 11.8 fl. oz. (0.35 L)
- ☐ 18.6 fl. oz. (0.55 L)
- ☐ 47.3 fl. oz. (1.4 L)
- ☐ 74.4 fl. oz. (2.2 L)
- ☐ 94.68 fl. oz. (2.8 L)

MANUFACTURED FOR:
Visjon Biologics
1092 S Graham ST.
Henrietta, TX 76365

EPA Registration No.: 91967-1
EPA Establishment No.: _____
Lot/Batch Code: _____

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Applicators and other handlers must wear: Long-sleeved shirt, long pants, waterproof gloves, protective eyewear, and shoes plus socks. Follow manufacturer's instructions for cleaning/maintaining PPE separately from other laundry.

DIRECTIONS FOR USE

It is a violation of federal laws to use this product in a manner inconsistent with its labeling.

To prevent contamination of the dilute solutions of EXCEED™ SAR PLUS by possible pesticide or other chemical residues in the spraying equipment, use dedicated equipment, or be sure that the equipment is thoroughly clean before use.

For Agricultural Use:

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. For any requirements specific to your State or Tribe, consult the agency responsible for pesticide regulation.

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 interval. 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.

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
- Waterproof gloves
- Protective eyewear, and
- Shoes plus socks

GENERAL INSTRUCTIONS

Shake before using. Following specific crop instructions for dilution rates and application usage. Do not apply within three days of harvesting. For best results use pH neutral (pH 6.9 to 7.0) mix water.

Crop	Mixing and Application Instructions
Garbanzo Bean	For seed treatment, apply 0.75 fluid ounces of product per 100 lbs. seed in conjunction with the inoculant product Exceed® SAR Custom Liquid for Garbanzo Bean. Apply as a water based slurry through standard slurry or mist-type commercial seed treatment equipment.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

PESTICIDE STORAGE: Store in original container in a cool, dry place away from sunlight and out of the reach of children and pets. Do not reuse container.

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: Nonrefillable container. Do not reuse or refill this container. Offer for recycling, if available. Triple rinse or pressure rinse container (or equivalent) promptly after emptying. {For product less than 5 gallons} 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 1/4 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. {For product greater than 5 gallons} Triple rinse as follows: Empty the remaining contents into application equipment or a mix tank. Fill the container 1/4 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 more times. An empty container retains vapor and product residue. Observe label safeguards until container is cleaned, reconditioned or destroyed. Completely empty contents into formulation equipment. Then offer for recycling or reconditioning or, dispose of container in a manner approved by state and local authorities.

WARRANTY

Visjon Biologics warrants that this product conforms to the chemical description on the label thereof and is reasonably fit for purposes stated on such label only when used in accordance with directions under normal use conditions. It is impossible to eliminate all risks inherently associated with use of this product. Crop injury, ineffectiveness or other unintended consequences may result because of such factors as weather conditions, the presence of other materials or the manner of use of application, all of which are beyond the control of Visjon Biologics. To the extent consistent with applicable law, Visjon Biologics shall not be liable for consequential, special or indirect damages resulting from the use or handling of this product. All such risks shall be assumed by the Buyer.

To the extent consistent with applicable law, the exclusive remedy of any buyer or use of this product for any and all losses, injuries, or damages resulting from or in any way arising from the use, handling, or application of the product, whether in contract, warranty, tort, negligence, strict liability, or otherwise, shall not exceed the purchase price paid for this product or at Visjon Biologics' election, the replacement of this product. Visjon Biologics MAKES NO WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PUROSE OR ANY OTHER EXPRESS OR IMPLIED WARRANTY EXCEPT AS STATED ABOVE.

{Co-Packaged Product Labeling – This product can be co-packaged with the Exceed® SAR Custom Liquid for Garbanzo Bean seed inoculant product}

EXCEED SAR CUSTOM LIQUID FOR GARBANZO BEAN

This liquid inoculant is intended to be applied on-seed. It is a culture of highly effective strain of rhizobia (nitrogen-fixing bacteria) that will colonize the plant roots to gather and fix the "free" nitrogen of the air, making it available to the plants.

Product 4004

Treats: 10,000# (4,535.9 kg) of seed or 200 units

Net Contents: One 10 L (338.1 fl oz) Bladder bag of Inoculant and One 2.2 liter (74.4 fl oz) Bladder bag of Exceed SAR Plant Defense Booster Plus
Package Configuration: One inoculant bladder and one Exceed SAR Plant Defense Booster Plus bladder per case, 54 cases per pallet

Product 4007
Treats: 2,500# (1,134 kg) of seed or 50 units
Net Contents: One 2.5 L (84.54 fl oz) Bladder bag of Inoculant and One .55 L (18.6 fl oz) Bladder bag of Exceed SAR Plant Defense Booster Plus
Package Configuration: 4 packages, each containing one inoculant bladder bag and one Exceed SAR Plant Defense Booster Plus bladder bag, 54 cases per pallet

CONTAINS NONPLANT FOOD INGREDIENTS
Minimum Guaranteed Analysis
Inoculant:
Active Ingredient: <1% by Weight
Mesorhizobium ciceri: 3.25 x 10^9 CFU/mL
Inactive Ingredients: >99% by Weight

KEEP OUT OF REACH OF CHILDREN
This product does not meet the regulatory definition of a hazardous chemical under 29 CFR 1910.1200. However, good industrial hygiene practices should be used in the manufacture and handling of the product.

Precautionary Information:
While Exceed SAR Custom Liquid for Garbanzo Bean is non-toxic it is recommended that the applicator avoid inhalation. Visjon Biologics recommends the use of gloves and eye protection while using Exceed SAR Custom Liquid for Garbanzo Bean.

This product is designed to be custom applied through an approved application device by a retail location that has been trained in the proper methods of handling and applying Exceed SAR Custom Liquid to garbanzo bean seed. Please read all directions and specifications carefully before using this product. This product contains live organisms that are sensitive to chemicals and harsh environmental conditions.

FOR RETAIL APPLICATION ONLY.
Directions for Application:
• Ensure that the treater has been properly calibrated.
• Shake each container well before use.
• Pour each container into mix tank.
• Agitate or recirculate liquid mixture to ensure proper distribution of bacteria and Exceed SAR Plus.
• Apply at a total rate of 4.15 fl oz (122.7 mL)/cwt (45.36 kg).

• Prepare only as much Exceed SAR Custom Liquid for Garbanzo Bean as will be used that day.
• Consult with a Visjon Biologics representative for a complete list of compatible seed treatments.
The product density of Exceed SAR Custom Liquid for Garbanzo Bean is 8.6 lbs/gal (1.03 g/mL).

Storage of Exceed SAR Custom Liquid for Garbanzo Bean:
• Always read and follow instructions.
• Store in a cool, dry place out of direct sunlight.
• Store product between 40º and 77º F (4º and 25º C.)
• Open package only when ready to use.
• Use before expiration date.
• Do not store in an area which is to be fumigated.
• Small amounts of product which cannot be used according to instructions may be disposed of in a landfill.

Expiration Date:
Exceed SAR Custom Liquid for Garbanzo Bean carries a one-season shelf life and expires the date stamped on the case.

Information regarding the contents and levels of metals in this product is available on the internet at: http://www.aapfco.org/metals.html

Limited Warranty:
VISJON BIOLOGICS GUARANTEES THIS CULTURE TO PRODUCE SATISFACTORY NODULE FORMATION AND NITROGEN FIXATION UNDER FAVORABLE CONDITIONS OF SOIL AND CLIMATE WHEN USED BEFORE EXPIRATION DATE AND APPLIED UNDER THE MANUFACTURER'S SPECIFICATIONS, OR PURCHASE PRICE WILL BE REFUNDED. A VISJON BIOLOGICS REPRESENTATIVE MUST BE NOTIFIED OF ANY FIELD COMPLAINT WITHIN FIFTY (50) DAYS AFTER PLANTING. MANY FACTORS OTHER THAN NODULATION AFFECT CROP PERFORMANCE. VISJON BIOLOGICS ASSUMES NO RESPONSIBILITY FOR LOSS OR PARTIAL LOSS OF CROP FROM ANY CAUSE WHATSOEVER. THIS LIMITED WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED. THE LIMITED WARRANTY IS VOID WHERE PROHIBITED BY LAW. IF YOU HAVE ANY QUESTIONS ABOUT THIS PRODUCT OR ANY OTHER VISJON BIOLOGICS PRODUCT, CALL 940-264-0343 FOR ASSISTANCE.

Visjon Biologics
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www.visjonbiologics.com
Exceed® is a registered trademark of Visjon Biologics.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF CHEMICAL SAFETY
AND POLLUTION PREVENTION

June 10, 2024

Micah T. Reynolds
Senior Managing Consultant
Organisan Corporation
c/o RAMBOLL
4245 North Fairfax Drive
Suite 700
Arlington, VA 22203

Subject: Non-PRIA (Pesticide Registration Improvement Act) Labeling Amendment – Addition of Use Sites and Pests
Product Name: NEMASAN
EPA Registration Number: 92032-1
Application Date: 10/10/2023
Action Code Case Number: 00491272

Dear Mr. Reynolds:

The amended labeling referred to above, submitted in connection with registration under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), as amended, is acceptable.

This approval does not affect any terms or conditions that were previously imposed on this registration. You continue to be subject to existing terms or conditions on your registration and any deadlines connected with them.

A stamped copy of your labeling is enclosed for your records. This labeling supersedes all previously accepted labeling. You must submit one (1) copy of the final printed labeling before you release this product for shipment with the new labeling. In accordance with 40 CFR § 152.130(c), you may distribute or sell this product under the previously approved labeling for 18 months from the date of this letter. After 18 months, you may only distribute or sell this product if it bears this new revised labeling or subsequently approved labeling. "To distribute or sell" is defined under FIFRA section 2(gg) and its implementing regulation at 40 CFR § 152.3.

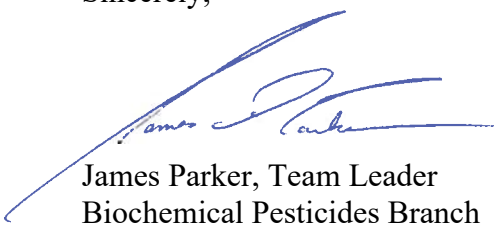
Should you wish to add/retain a reference to your company's website on your label, then please be aware that the website becomes labeling under FIFRA and is subject to review by the U.S. Environmental Protection Agency (EPA). If the website is false or misleading, the product will be considered to be misbranded and sale or distribution of the product is unlawful under FIFRA section 12(a)(1)(E). 40 CFR § 156.10(a)(5) lists examples of statements the EPA may consider false or misleading. In addition, regardless of whether a website is referenced on your product's label, claims

made on the website may not substantially differ from those claims approved through the registration process. Therefore, should the EPA find or if it is brought to our attention that a website contains false or misleading statements or claims substantially differing from the EPA-approved registration, the website will be referred to the EPA's Office of Enforcement and Compliance Assurance.

Your release for shipment of this product constitutes acceptance of these terms. If these terms are not complied with, this registration will be subject to cancellation in accordance with FIFRA section 6.

If you have any questions, please contact Chris Pfeifer of my team by phone at (202) 566-1599 or via email at pfeifer.chris@epa.gov.

Sincerely,



James Parker, Team Leader
Biochemical Pesticides Branch
Biopesticides and Pollution
Prevention Division (7511P)
Office of Pesticide Programs

Enclosure

{Note to Reviewer: Text in [brackets] is optional or alternate wording. Text in {braces} is information and may not appear on final commercial label.}

NEMASAN

(Alternate Brand Names: ChitoPro, ChitoPro-I, ChitoPro-F, OmniCoat, OmniKote, TriKoat, TriKote, Domo, Avant, Assure, Chitosap, Chitolaya, Chito-Fix, Chito-Mend, Chito-X, Fungasan, Fungol, Mycol, Mycosan, Mycosan-Q, Myco-Cide, Quillol, Quilla-Cide, Quilla-Cide, Verdant)

Biological Nematicide, Insecticide, and Fungicide
For [effective] control/ suppression of plant-parasitic nematodes in the soil, listed insect pests, and listed plant diseases
For application to turf, fruit, vegetables, ornamentals, and row crops
For application as a seed treatment to control [plant-parasitic] nematodes and listed plant diseases
Nematode Suppression/Control
[Suppresses] [Controls] listed insects, soil and foliar fungal pathogens
{Label Reviewer Notes: Optional claims are also listed on last page}

Active Ingredients:

Quillaja Extract*.....	8.0%
Chitosan.....	2.0%
Other Ingredients.....	90.0%
Total	100.0%

*Product contains 0.69% Saponins of *Quillaja saponaria*

ACCEPTED
06/10/2024
Under the Federal Insecticide, Fungicide and Rodenticide Act as amended, for the pesticide registered under EPA Reg. No. 92032-1

KEEP OUT OF REACH OF CHILDREN

DANGER PELIGRO

Si usted no entiende la etiqueta, busque a alguien para que se la explique a usted en detaile. (If you do not understand the label, find someone to explain it to you in detail.)

FIRST AID	
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 treatment advice.
HOT LINE NUMBER Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-800-222-1222 for emergency medical treatment information.	

See [back] [side] [other] [panel] [booklet] [insert] for additional information [precautionary statements] [and] [directions for use].

EPA Reg. No. 92032-1 **EPA Establishment No. _____**

Net Contents: [X oz.] [X quart(s)] [X gallon(s)] [2 x X gallons]

{Note to reviewer: the appropriate bracketed net content unit will be used on the commercial label.}

Manufactured exclusively for:

Organisan corporation

PO Box 2085
Carrollton, GA 30112

{Note to Reviewer: Text in [brackets] is optional or alternate wording. Text in {braces} is information and may not appear on final commercial label.}

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS - DANGER. Corrosive. Causes irreversible eye damage. Do not get in eyes or on clothing. Wear goggles or face shield. After product is diluted in accordance with the directions for use, goggles or face shield is not required. 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.

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 interval. 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.

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:

- Long-sleeved shirt and long pants
- Shoes plus socks

[NEMATICIDAL] [FUNGICIDAL] [INSECTICIDAL] USE INSTRUCTIONS

Nemasan [this product] is a [nematicide], [fungicide], [and] [insecticide] for use on agricultural crops against the pests listed in the Directions for Use section. Apply Nemasan [this product] as a soil treatment to control listed soil-borne [pests] [diseases] [and larvae of pests], and apply Nemasan [this product] as a foliar spray or as a soil treatment (soil drench, in-furrow, drip-applied) to control listed [insect pests], [nematodes], [and] [plant diseases]. For seed treatment uses, please refer to the Seed Treatment Use Instructions.

Mixing Directions

Follow manufacturer's guidelines for cleaning spray equipment prior to mixing. Fill tank to desired amount with water, add all other spray components and agitate as directed. Buffer the mixture to pH 5.0 or below before adding Nemasan. Start the mechanical or hydraulic agitation to provide moderate circulation before adding Nemasan. Add the desired volume of Nemasan to the mix tank and the remaining volume of water and continue circulation. Maintain circulation while loading and spraying. (Excessive agitation may lead to foaming of spray solution.) Do not mix more Nemasan than can be used in 24 hours.

Tank Mixing

Do not combine Nemasan [this product] in the spray tank with other pesticides, surfactants, adjuvants, or fertilizers if there has been no previous experience or use of the combination to show it is physically compatible, effective, or non-injurious under your use conditions.

To ensure compatibility of tank-mix combinations they must be evaluated prior to use. To determine the physical compatibility of this product with other products use a jar test. Using a quart jar, add the proportionate amounts of the products to one quart of water with agitation. Add dry formulations first, then flowables second, then emulsifiable concentrates last. After thoroughly mixing, let this mixture stand for 5 minutes. If the combination

remains mixed or can readily be remixed, it is physically compatible. Once compatibility has been proven, use the same procedure for adding required ingredients to the spray tank.

Nematicide Application Instructions (Soil and Foliar)

Apply Nemasan [this product] to the soil as a pre-plant, at planting or post-plant soil treatment on annual and perennial crops (refer to Directions for Use Table) alone, or applied through drip or border irrigation systems. Best results will be obtained from pre-plant applications close to the actual planting times. The optimal application time must be determined based on the cultural practices and the nematode population dynamics. Nemasan [This product] is formulated to work in synergy with resident soil microflora to enhance an environment that is detrimental to nematodes. For application areas that have undergone recent or multi-season soil fumigant applications for sterilization, initial Nemasan [product] effectiveness and nematode suppression/control may be impacted, For treatment areas that have recent or multi-season soil fumigant applications, more frequent Nemasan [product] applications may be needed for optimum nematode population control.

For perennial crops, apply Nemasan [this product] just prior to a root flush to protect young roots. Multiple applications may be required for crops with multiple root flushes. Nemasan [This product] may be applied to and incorporated into the soil. Incorporation may be accomplished by mechanical equipment, irrigation or rainfall. For soil applications made at planting, the action of some planters may provide sufficient incorporation. When using planters which do not provide adequate incorporation of Nemasan into the soil, equipment designed for incorporation may be used behind the planter.

Close scouting and early attention to infestations is highly recommended. Proper timing of application targeting newly hatched larvae, eggs or immature pests is important for optimal results.

Nemasan [This product] can be applied to bare soil alone or with most types of pesticides and nutrients prior to planting, at planting, at transplant, in-season, pre- and post-harvest. Apply with a minimum of 10-30 gallons of water per acre to ensure complete coverage. Use a jar test to confirm physical compatibility prior to application. Apply 1-2 pints of Nemasan [product] per acre. Applications can be made by following methods:

Pest	Application Timing	Application Method	Rate	Comments
Root-lesion nematode *Pratylenchus spp.* Root-knot nematode *Meloidogyne spp.* Reniform nematode *Rotylenchulus spp.* Sting nematode *Belonolaimus spp.* Stem nematode *Ditylenchus spp.* Gall nematode *Agnuina spp.* Soybean Cyst Nematode *Heterodera spp.* Spiral nematode *Helicotylenchus spp.* Lance nematode *Hoplolaimus spp.* Guava nematode *Meliodogyne spp.* Potato cyst nematode *Globodera spp.*	Before Planting At Planting Transplanting In Season Pre-Harvest Post-Harvest	Drenching, drip (trickle) or sprinkler application Surface spray on moist soil with 40-100 gallons water/acre Surface spray with 20-40 gallons water/acre followed by overhead irrigation. Use enough irrigation water to wet the soil into the root zone. Direct injection to anticipated root depth using shank or other soil injection equipment. Apply with 30-40 gallons water/acre.	Apply 1-2 pints of product per acre	Pre-plant applications may be either broadcast over an entire field or concentrated (banded) into planting rows. Apply when soil temperature at 4-inch depth is 60°F or higher. Bioactivity of Nemasan is greatest at soil temperatures between 70° and 90°F. Apply to nematode-infested (non-fumigated) soil up to 14 days before planting or transplanting. Retreat every 7 to 21 days as needed for control.

Insecticide/Miticide Application Instructions (Soil and Foliar)

Apply Nemasan [product] in sufficient amount of water and adequate spray pressure to achieve thorough coverage of plant surfaces to listed crops to control listed insect pests, including aphids, thrips, psyllids, mites, and beetles. Nemasan [this product] is most effective when applied before or around the onset of insects, mites, or their eggs or as soon as pest emergence is evident. For application areas that have undergone recent or multi-season soil fumigant applications for sterilization, initial Nemasan [product] effectiveness and insect suppression/control may be impacted, For treatment areas that have recent or multi-season soil fumigant applications, more frequent Nemasan [product] applications may be needed for optimum insect population control. Apply Nemasan [product] at a rate of 1-2 pints per acre in a minimum of 10-30 gallons of water to ensure adequate coverage. Ensure that both the top and bottom of leaves are wetted but not to the point of runoff. For optimum results, repeat the applications at intervals of 7 to 21 days. Use higher rates and increase spray frequency when pest pressure is high. Use any powered or manual conventional spray application equipment including high volume, low volume, ultra-low volume, backpack, or chemigation (refer to Chemigation section of the label). For all applications, follow the original equipment manufacturer's instructions.

Insect Pest	Application Timing	Application Method	Rate	Comments
White flies - egg, nymph Aphids - all life stages, not adult Thrips - egg, larvae, prepupal, pupal Stink Bugs - egg, nymph Plant Bugs - egg, nymph Psyllids - egg, all 5 instar Wireworms - egg, larvae Corn Borers - egg, larvae Corn Root Worm - egg, larvae instars Southern Cow Pea Weevil - egg, larvae, maggot Pea Weevils (Curcula) - all life stages, not adult Mites - all life stages, not adult Sugarcane Aphids - all life stages, not adult Corn Ear Worm - all life stages, not adult Corn Root Maggot - all life stages, not adult Borers - all life stages Pine Beetles Snails & Slugs - all life stages Grasshoppers - egg, larvae Colorado Potato Beetle Cereal Leaf Beetle Wireworm Leaf Miners Mealy Bugs Crickets - egg, larvae	At earliest sign of pest intrusion	In-Furrow, Soil or Foliar Drench, drip (trickle) or sprinkler application pre-plant, post-plant, post-emergence, in-season, pre-harvest Surface spray with 10-30 gallons water/acre	Apply 1-2 pints of product per acre	Retreat every 7 to 21 days as needed for control.

Fungicide Application Instructions (Soil and Foliar)

Apply Nemasan [product] in sufficient amount of water and adequate spray pressure to achieve thorough coverage of plant surfaces to listed crops to control listed plant and turf diseases, including rot, *Phytophthora spp*, and *Fusarium spp*. Nemasan [This product] is most effective when applied before or around the onset of disease occurrence. For application areas that have undergone recent or multi-season soil fumigant applications for sterilization, initial Nemasan [product] effectiveness and disease suppression/control may be impacted, For treatment areas that have recent or multi-season soil fumigant applications, more frequent Nemasan [product] applications may be needed for optimum disease control. Apply Nemasan [product] at a rate of 1-2 pints per acre in a minimum of 10-30 gallons of water to ensure adequate coverage. Ensure that both the top and bottom of leaves are wetted but not to the point of runoff. For optimum results, repeat the applications at intervals of 7 to 21

days. Use higher rates and increase spray frequency when pest pressure is high. Use any powered or manual conventional spray application equipment including high volume, low volume, ultra-low volume, backpack, or chemigation (refer to Chemigation section of the label). For all applications, follow the original equipment manufacturer's instructions.

Plant Disease	Application Timing	Application Method	Rate	Comments
Crop Diseases, including: *Rhizoctonia spp. (R. solani)* Garlic and Onion White Rot Onion Pink Root Rot *Fusarium spp. (F. oxysporium, F. solani, F. graminearum)* *Aspergillus spp.* *Pseudomonas spp.* *Phytophthora spp.* *Phytophthora gummosis* Phytophthora Root Rot Bacterial Soft Rot Armillaria Root Rot Bacterial Blast Sooty Mold Alternaria Melanose Verticillium Gray Rot, Noble Rot (*B. cinerea)* Botrytis Bunch Rot (*B. cinerea)* *Pythium spp.* Pink Root Pink Rot Potato Soft Rot Early Blight Late Blight Bacterial Blight Downy Mildew Collar Rot Stem Rot Rust *Rhizosphaera* Needle Cast Slime Mold *Ascochyta* Leaf Blight	At earliest sign of disease occurrence	In-Furrow, Soil or Foliar Drench, drip (trickle) or sprinkler application pre-plant, post-plant, post-emergence, in-season, pre-harvest Surface spray with 10-30 gallons water/acre	Apply 1-2 pints of product per acre	Retreat every 7 to 21 days as needed for control.
Turf and Sod Diseases, including: Curvularia Leaf Spot Fairy Ring Anthracnose Brown Patch Gray Leaf Spot Downy Mildew Powdery Mildew Spring Root Dieback Dollar Spot *Pythium spp.* Summer Patch Red Thread Take All Patch *Ascochyta* Leaf Blight				

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FOR USE ON THE FOLLOWING CROPS FOR CONTROL/ SUPRESSION OF SPECIFIED NEMATODES, INSECT PESTS, AND PLANT DISEASES

Pre-harvest Interval (PHI) = 0 days

Crop Grouping	**(including)**
Cereal Grains [Crop Group 15]	Barley, Buckwheat, Corn (sweet and field), Millet, Oats, Quinoa, Popcorn, Rice, Rye (annual and cereal), Sorghum, Teosinte, Triticale, Milo, Wheat, Grain Amaranth
Berries and Small Fruit [Crop Group 13]	Bayberry, Bearberry, Bilberry, Blackberry, Blueberry, Buffaloberry, Che, Chilean guava, Chokeberry, Cloudberry, Cranberry, Currant, Elderberry, Gooseberry, Grape, Huckleberry, Kiwifruit, Lingonberry, Loganberry, Mulberry, Raspberry, Strawberry
Brassica (Cole) Leafy Vegetables [Crop Group 5]	Broccoli, Broccoli Raab, Brussels Sprouts, Cabbage, Chinese Broccoli, Chinese Cabbage (Bok Choy), Chinese Cabbage (Napa), Chinese Mustard Cabbage (Gai Choy), Cauliflower, Cavalo Broccolo, Collards, Kale, Kohlrabi, Mizuna, Mustard Greens, Mustard Spinach, and Rape Greens
Bulb Vegetables [Crop Group 3]	Chive, Daylily, Elegans hosta, Fritillaria, Leek, Garlic, Kurrat, Onion (Bulb and Green) and Shallot
Citrus [Crop Group 10]	Calamondin, Citron, Lemon, Orange, Lime, Grapefruit, Kumquat, Pummelo, Mandarin, Satsuma, Tangerine
Cotton	
Cucurbit Vegetables [Crop Group 9]	Cucumber, Edible Gourds, Muskmelon, Cantaloupe, Pumpkin, Watermelon, and Winter and Summer Squash, Chinese waxgourd, Gherkin, Chayote
Fruiting Vegetables [Crop Group 8]	Tomato, Tomatillo, Pepper, Ground cherry, Pepino, Okra and Eggplant
Grass Forage, Fodder and Hay [Crop Group 17]	Bermuda grass; bluegrass; and bromegrass or fescue, Bahia grass (*Paspalum spp*.) Orchard grass, Timothy grass, Crested Wheat Grass, Intermediate Wheat Grass
Hemp	
Leafy Vegetables [Crop Group 4]	Arugula, Cardoon, Celery, Celtuce, Corn Salad, Cress, Dandelion, Dock, Edible Chrysanthemum, Endive, Fennel, Head Lettuce, Leaf Lettuce, Parsley, Purslane, Radicchio, Rhubarb, Spinach and Swiss Chard
Legume Vegetables (Succulent or Dried) and Foliage [Crop Groups 6 & 7]	Bean (Lupinus) (includes grain lupin, sweet lupin, white lupin, and white sweet lupin); bean (Phaseolus) (includes field bean, kidney bean, lima bean, navy bean, pinto bean, runner bean, snap bean, tepary bean, wax bean); bean (Vigna) (includes adzuki bean, asparagus bean, blackeyed pea, catjang, Chinese longbean, cowpea, crowder pea, moth bean, mung bean, rice bean, southern pea, urd bean, yardlong bean); broad bean (fava); chickpea (garbanzo); guar; jackbean; lablab bean; lentil; pea (Pisum) (includes dwarf pea, edible-podded pea, English pea, field pea, garden pea, green pea, snowpea, sugar snap pea); pigeon pea; soybean; soybean (immature seed); sun hemp; sword bean
Oilseed Crops [Crop Group 20]	Rapeseed, canola, sunflower, safflower, flax seed, cottonseed, sesame, borage, calendula, castor oil plant, crambe, cuphea, echium, euphorbia, evening primrose, gold of pleasure, hare's ear mustard, jojoba, lesquerella, lunaris, meadowfoam, milkweed, mustard seed, niger seed, rose hip, oil radish, poppy seed, stokes aster, sweet rocket, tallowwood, tea oil plant, vernonia
Ornamentals	Bare root, container bedding and landscape, shade and flowering trees, woody ornamentals
Peanut	
Pome Fruits [Crop Group 11]	Apple, Crabapple, Loquat, Mayhaw, Pear, Quince
Root and Tuber Vegetables and Leaves [Crop Groups 1 & 2]	Arracacha, Arrowroot, Artichoke, Black Salsify, Canna, Carrot, Cassava, Celeriac, Chayote Root, Chervil, Chicory, Chufa, Chinese Artichoke, Dasheen, Edible Burdock, Garden Beet, Ginger, Ginseng, Horseradish, Leren, Jerusalem Artichoke, Oriental Radish, Parsnip, Potatoes, Radish, Rutabaga, Salsify, Skirret, Spanish Salsify, Sugar Beet, Sweet Potatoes, Tumeric, Turnip, Turnip-rooted Chervil, Turnip-rooted Parsley and Yams
Sugarcane	
Tobacco	

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Tree Nuts [Crop Group 14]	Almond, Beech nut, Brazil nut, Butternut, Cashew, Chestnut, Chinquapin, Coconut, Filbert (hazelnut), Hickory nut, Macadamia nut, Pecan, Pine nut, Pistachio, Walnut (black and English)
Tree Nurseries	Christmas trees, Fir, Pine, Oak, Spruce, Noble Fir, Scotch Pine, Balsam Fir, Douglas-Fir, Elm, Ash, Hickory, Poplar, Cedar, Holly, Locust, and other tree varieties for commercial use or reforestation
Turfgrass	Residential Lawns, Commercial Lawns, Ornamental lawns, athletic fields, golf courses, sod farms
Tropical and Subtropical Fruit, Edible Peel [Crop Group 23]	Acai, Acerola, Achachairu, African plum, Agritos, Almondette, Apak palm, Appleberry, Araza, Arbutus berry, Babaco, Bacaba palm, Bacaba-de-leque, Bayberry, Bignay, Bilimbi, Borojo, Breadnut, Cabeluda, Cajou, Cambuca, Carandas-plum, Carob, Cashew apple, Ceylon iron wood, Ceylon olive, Cherry-of-the-Rio-Grande, Chinese olive, Chirauli-nut, Ciruela verde, Cocoplum, Date, Davidson's plum, Desert-date, Doum palm coconut, False sandalwood, Feijoa, Fig, Fragrant manjack, Gooseberry, Governor's plum, Grumichama, Guabiroba, Guava, Guayabillo, Illawarra plum, Imbe, Imbu, Indian-plum, Jaboticaba, Jamaica-cherry, Jambolan, Jelly palm, Jujube, Kaffir-plum, Kakadu plum, Kapundung, Karanda, Kwai muk, Lemon aspen, Mangaba, Marian plum, Mombin, Monkeyfruit, Monos plum, Mountain cherry, Nance, Natal plum, Noni, Olive, Papaya, Pataua, Peach palm, Persimmon, Pitomba, Plum-of-Martinique, Pomerac, Rambai, Rose apple, Rukam, Rumberry, Sea grape, Sentul, Sete-capotes, Silver aspen, Starfruit, Surinam cherry, Tamarind, Uvalha, Water apple, Water pear, Water berry, Wax jambu
Tropical and Subtropical Fruit, Inedible Peel [Crop Group 24]	Abiu, Aisen, Akee apple, Atemoya, Avocado, Bacury, Bael fruit, Banana, Binjai, Biriba, Breadfruit, Burmese grape, Canistel, Cat's-eyes, Champedak, Cherimoya, Cupuacu, Custard apple, Dragon fruit, Durian, Elephant apple, Etambe, Granadilla, Ilama, Inga, Jackfruit, Jatoba, Karuka, Kei apple, Langsat, Lanjut, Longan, Lucuma, Lychee, Mabolo, Madras-thorn, Mammy-apple, Manduro, Mango, Mangosteen, Marang, Marmaladebox, Matisia, Mesquite, Mongongo, Monkey-bread-tree, Monstera, Nicobar-breadfruit, Paho, Pandanus, Papaya, Passionflower, Passionfruit, Pawpaw, Pelipisan, Pequi, Pequia, Persimmon, Pineapple, Pitahaya, Pitaya, Plantain, Pomegranate, Poshte, Prickly pear, Pulasan, Quandong, Rambutan, Saguaro, Sapodilla, Sapote, Sataw, Satinleaf, Screw-pine, Sierra Leone-tamarind, Soncoya, Soursop, Spanish lime, Star apple, Sugar apple, Sun sapote, Tamarind-of-the-Indies, Velvet tamarind, Wampi, White star apple, Wild loquat

Crop Grouping (Con't)	**(including)**
Herbs and Spices [Crop Groups 19, 25, 26]	Allspice, Angelica, Anise, Star Anise, Annatto, Balm, Basil, Borage, Burnet, Camomile, Caper buds, Caraway, Cardamom, Cassia (buds and bark), Catnip, Celery seed, Chervil, Chive, Cinnamon, Clary, Clove buds, Coriander, Cilantro, Costmary, Culantro, Cumin, Curry, Dill, Fennel, Fenugreek, Grains of Paradise, Horehound, Hyssop, Juniper berry, Lavender, Lemongrass, Lovage, Mace, Marigold, Marjoram, Mint, Mustard, Nasturtium, Nutmeg, Oregano, Parsley, Pennyroyal, Pepper (white and black), Peppermint, Rosemary, Rue, Saffron, Sage, Savory, Spearmint, Sweet bay, Tansy, Tarragon, Thyme, Vanilla, Wintergreen, Woodruff, Wormwood
Stalk, Stem, and Leaf Petiole Vegetables [Crop Group 22]	Agave, Aloe Vera, Asparagus, Bamboo shoots, Cardoon, Celery, Celtuce, Fennel, Fern, Fuki, Kale, Kohlrabi, Palm hearts, Prickly pear, Rhubarb, Udo, Zuiki
Stone Fruits [Crop Group 12]	Apricot, Capulin, Cherry, Jujube, Nectarine, Peach, Plum, Plumcot, Prune, Sloe
Hops	
Nongrass Animal Feeds [Crop Group 18]	Alfalfa, Velvet Bean, Clover, Lespedeza, Lupin, Sainfoin, Trefoil, Vetch (crown and milk), Bahia grass (*Paspalum spp.*)

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CHEMIGATION

General Requirements:

- Apply [Nemasan] [this product] at 1 – 2 pints per acre as a pre-plant, at planting, post-plant soil treatment for control of nematodes or apply via foliar spray for treatment of listed insects and diseases.
- Apply [Nemasan] [this product] only through 1) overhead boom and mist-type systems, 2) sprinklers such as center pivot, lateral move, end tow, side (wheel) roll, traveler, big gun, solid set, impact or micro-sprinklers or hand-move systems, 3) pressurized drench (flood), furrow, border, or drip (trickle) systems, 4) micro-irrigation such as spaghetti tube or individual tube irrigation, 5) hand-held calibrated irrigation equipment such as hand-held wand with injector, and 6) ebb and flow 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.

Application Instructions for All Types of Chemigation:

1) Remove scale, pesticide residues, and other foreign matter from the chemical supply tank and entire injector system. Flush with clean water. Failure to provide a clean tank, void of scale or residues, may cause [Nemasan] [this product] to lose effectiveness or strength.
2) Determine the treatment rates as indicated in the directions for use and make proper dilutions.
3) To mix in supply tank, fill tank half way with water and add [Nemasan] [this product]. Stir until completely dispersed. Fill tank with remaining amount of water.
4) Application of [Nemasan] [this product] may be made continuously for the duration of the water application or can be applied at the end or after the water application.

Requirements for Chemigation Systems Connected to Public Water Systems:

1) 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.
2) 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 flow 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.
3) The pesticide injection pipeline must contain a functional, automatic, quick-closing check valve to prevent the flow of fluid back toward the injection.
4) 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.
5) 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.
6) 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.
7) Do not apply when wind speed favors drift beyond the area intended for treatment.
8) Continuous agitation is not required in pesticide supply tanks unless tank mixing with other products or fluid fertilizers that require it.

Sprinkler Chemigation Requirements:

1) 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.
2) The pesticide injection pipeline must contain a functional, automatic, quick-closing check valve to prevent the flow of fluid back toward the injection pump.
3) 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.
4) The system must contain functional interlocking controls to automatically shut off the pesticide injection pump when the water pump motor stops.
5) The irrigation line or water pump must include a functional pressure switch that will stop the water pump motor when the water pressure decreases to the point where pesticide distribution is adversely affected.
6) 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.
7) Do not apply when wind speed favors drift beyond the area intended for treatment.
8) Continuous agitation is not required in pesticide supply tanks unless tank mixing with other products or fluid fertilizers that require it.

Drip (Trickle) Chemigation Requirements:

1) 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.
2) The pesticide injection pipeline must contain a functional, automatic, quick-closing check valve to prevent the flow of fluid back toward the injection pump.
3) 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.
4) The system must contain functional interlocking controls to automatically shut off the pesticide injection pump when the water pump motor stops.
5) The irrigation line or water pump must include a functional pressure switch that will stop the water pump motor when the water pressure decreases to the point where pesticide distribution is adversely affected.
6) 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.
7) Use of a supply tank is recommended. Continuous agitation is not required in pesticide supply tanks unless tank mixing with other products or fluid fertilizers that require it.

Floor (Basin), Furrow, and Border Chemigation Requirements:

1) Systems using a gravity flow pesticide dispensing system must meter the pesticide into the water at the head of the field and downstream of a hydraulic discontinuity such as a drop structure or weir box to decrease potential for water source contamination from back flow if water flow stops.
2) Systems utilizing a pressurized water and pesticide injection system must meet the following requirements:
   a. 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.
   b. The pesticide injection pipeline must contain a functional, automatic, quick-closing check valve to prevent the flow of fluid back toward the injection pump.
   c. 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.
   d. The system must contain functional interlocking controls to automatically shut off the pesticide injection pump when the water pump motor stops.
   e. The irrigation line or water pump must include a functional pressure switch that will stop the water pump motor when the water pressure decreases to the point where pesticide distribution is adversely affected.

f. 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.

3) Use of a supply tank is recommended. Continuous agitation is not required in pesticide supply tanks unless tank mixing with other products or fluid fertilizers that require it.

SEED TREATMENT USE INSTRUCTIONS

Nemasan [This product] is a biochemical seed treatment that provides early season protection against listed plant parasitic nematodes, plant diseases, and insects. Nemasan also helps establish a vigorous root system that results in greater yields, more uniform foliage, and overall enhanced plant health. Nemasan must be used only in accordance with use instructions on this label utilizing conventional acceptable seed treatment techniques, provided that the equipment can be calibrated to accurately and uniformly apply the product to the seed. Nemasan [This product] is for both commercial and on-farm application. If Nemasan [this product] is used for commercial seed treatment, treated seed must be labeled in accordance with the requirements of the Federal Seed Act and applicable State seed laws. If this product is intended for seed treatment at-planting, treat only those seeds needed for immediate use, minimizing the interval between treatment and planting.

Seed Quality and Storage of Treated Seed

Seed treatments applied to low vigor, poor quality, or mechanically damaged seed may result in loss of seed germination or reduced seedling vigor. Prior to treatment of an entire seed lot, verify seed viability by treating a small portion of seed with the desired slurry mixture (Nemasan [this product] alone or in combination with other commercial seed treatment products). Utilize standard seed germination methodologies to determine and verify seed viability. Properly store treated seed. Due to seed quality and seed storage conditions beyond the control of [Organisan Corporation] [the registrant], no claims are made to guarantee the germination of carry-over treated seed.

Label Requirements of Treated Seeds

The Federal Seed Act requires that bags containing treated seed be labeled or tagged with the following information:

- This seed has been treated with chitosan and quillaja extract.
- Store treated seed away from food and feedstuffs.
- Wear long pants, long-sleeved shirt, and protective gloves when handling treated seed.

Mixing Instructions

Accurate application of Nemasan [this product] to seed is required for best performance. Dilute Nemasan [this product] with water (buffered to pH 5.0 or below) or distilled water. Apply as a water-based suspension of adequate volume to distribute product uniformly over seed surface area at a rate of 1 – 8 ounces per 100 lbs seed. The volume of suspension will vary according to seed type and whether companion seed treatments are used. Thoroughly pre-mix Nemasan [product] with water to ensure a uniform suspension. To verify compatibility with other seed treatment products, pre-test tank mixtures to evaluate formulation and proper physical compatibility of products. Nemasan [This product] can be applied alone or with other seed treatment pesticides or other seed-applied products through commercial seed-treating equipment. Buffer the mixture to pH 5.0 or below before adding Nemasan [product]. Avoid storing wet seed as germination may be reduced if seed is not planted shortly after treatment.

When applied with seed treatment application equipment designed to treat seed utilizing a treatment slurry mixture, add approximately ½ to ⅔ of the required water (buffered to pH 5.0 or below or distilled) to the treatment slurry tank followed by the accompanying seed treatment products and Nemasan [this product]. The order of product addition is dependent on the accompanying seed treatment products and application equipment

used. Determine required amount of each tank mix component based on rate, seed size, and amount of seed to be treated. Fill mix tank with required amount of water (pH buffered or distilled) followed by Nemasan [this product], all seed treatment components, and seed colorant (if required). Allow each slurry component to disperse completely prior to the next addition until a uniform suspension is obtained. Ensure all products are uniformly mixed prior to use. After all slurry components have been added and dispersed completely add the remaining ½ to ⅓ of required water (pH buffered or distilled) for proper slurry volume and mix until uniform. Do not store mixed slurries for greater than 24 hours. Maintain adequate agitation until treatment slurry is applied.

Target Pests

Nemasan [this product] is effective against the following nematode, insect, and plant disease pests:

Nematode Pests: Root-lesion nematode (*Pratylenchus spp*.), Root-knot nematode (*Meloidogyne spp*.), Reniform nematode (*Rotylenchulus spp*.), Sting nematode (*Belonolaimus spp.)*, Stem nematode (*Ditylenchus* spp.), Gall nematode (*Anguina spp*.), Soybean Cyst Nematode (*Heterodera spp*.), Spiral Nematode (*Helicotylenchus spp*.), Lance Nematode (*Hoplolaimus spp.*), Guava nematode (*Meliodogyne spp.*), Potato cyst nematode (*Globodera spp.*)

Fungal and Bacterial Diseases: *Rhizoctonia spp. (R. solani),* Garlic and Onion White Rot, Onion Pink Root Rot, *Fusarium spp. (F. oxysporium, F. solani, F. graminearum), Aspergillus spp., Pseudomonas spp., Phytophora spp., Phytophora gummosis*, Phytophora Root Rot, Bacterial Soft Rot, Armillaria Root Rot, Bacterial Blast, Sooty Mold, Alternaria, Melanose, Verticullium, Curvularia, Leaf Spot, Fairy Ring, Anthracnose, Brown Patch, Gray Leaf Spot, Gray Rot, Noble Rot, and Botrytis Bunch Rot (*B. cinerea),* Pink Root, Pink Rot, Potato Soft Rot, *Pythium spp*., Early Blight, Late Blight, Bacterial Blight, Downy Mildew, Collar Rot, Stem Rot, Powdery Mildew, Spring Root Dieback, Dollar Spot, *Rhizosphaera* Needle Cast, Red Thread, Summer Patch, Rust, Take All Patch, *Ascochyta* Leaf Blight, Slime Mold.

Insect Pests: White flies (egg, nymph), Aphids (all life stages except adult), Thrips (egg, larvae, pre-pupal, pupal), Stink Bugs (egg, nymph), Plant Bugs (egg, nymph), Psyllids (egg, all 5 instar stages), Wireworms (egg, larvae), Corn Borers (egg, larvae), Corn Root Worm (egg, larvae instars), Southern Cow Pea Weevil (egg, larvae, maggot), Pea Weevils/Curcula (all life stages except adult), Mites (all life stages except adult), Sugarcane Aphids (all life stages except adult), Corn Ear Worm (all life stages except adult), Corn Root Maggot (all life stages except adult), Borers (all life stages), Pine Beetles, Snails (all life stages), Slugs (all life stages), Grasshoppers (egg, nymph), Colorado Potato Beetle, Cereal Leaf Beetle, Leaf Miners, Mealy Bugs, Crickets (egg, larvae)

Application Rates

Specific application rates are listed below per crop; however, increased application rates of up to 8 ounces Nemasan [this product] per 100 lbs seed can accommodate increased pest pressure and/or increased coating efficiency to account for differences in individual seed morphology and surface characteristics. Application rates vary per crop but do not exceed 8 oz. per 100 lbs seed. Product application by seed weight translates into different numbers of seeds within varieties and species which can affect coating efficiency. The rate ranges provided account for variances in individual seed weight, seed sizes, and seed morphology between crop species within the same group.

Crop Grouping	Including	Application Rate
Cereal Grains [Crop Group 15]	Barley, Buckwheat, Corn (sweet and field), Millet, Oats, Quinoa, Popcorn, Rice, Rye (annual and cereal), Sorghum, Teosinte, Triticale, Milo, Wheat, Grain Amaranth	1-4 oz/100 lbs seed

Berries and Small Fruit [Crop Group 13]	Bayberry, Bearberry, Bilberry, Blackberry, Blueberry, Buffaloberry, Che, Chilean guava, Chokeberry, Cloudberry, Cranberry, Currant, Elderberry, Gooseberry, Grape, Huckleberry, Kiwifruit, Lingonberry, Loganberry, Mulberry, Raspberry, Strawberry	2-4 oz/100 lbs seed
Brassica (Cole) Leafy Vegetables [Crop Group 5]	Broccoli, Broccoli Raab, Brussels Sprouts, Cabbage, Chinese Broccoli, Chinese Cabbage (Bok Choy), Chinese Cabbage (Napa), Chinese Mustard Cabbage (Gai Choy), Cauliflower, Cavalo Broccolo, Collards, Kale, Kohlrabi, Mizuna, Mustard Greens, Mustard Spinach, and Rape Greens	2-4 oz/100 lbs seed
Bulb Vegetables [Crop Group 3]	Chive, Daylily, Elegans hosta, Fritillaria, Leek, Garlic, Kurrat, Onion (Bulb and Green) and Shallot	2-4 oz/100 lbs seed
Citrus [Crop Group 10]	Calamondin, Citron, Lemon, Orange, Lime, Grapefruit, Kumquat, Pummelo, Mandarin, Satsuma, Tangerine	2-4 oz/100 lbs seed
Cotton		4-6 oz/100 lbs seed
Cucurbit Vegetables [Crop Group 9]	Cucumber, Edible Gourds, Muskmelon, Cantaloupe, Pumpkin, Watermelon, and Winter and Summer Squash, Chinese waxgourd, Gherkin, Chayote	1-4 oz/100 lbs seed
Fruiting Vegetables [Crop Group 8]	Tomato, Tomatillo, Pepper, Ground cherry, Pepino, Okra and Eggplant	1-4 oz/100 lbs seed
Grass Forage, Fodder and Hay [Crop Group 17]	Bermuda grass; bluegrass; and bromegrass or fescue, Bahia grass (*Paspalum spp*.) Orchard grass, Timothy grass, Crested Wheat Grass, Intermediate Wheat Grass	1-4 oz/100 lbs seed
Hemp		2-4 oz/100 lbs seed
Leafy Vegetables [Crop Group 4]	Arugula, Cardoon, Celery, Celtuce, Corn Salad, Cress, Dandelion, Dock, Edible Chrysanthemum, Endive, Fennel, Head Lettuce, Leaf Lettuce, Parsley, Purslane, Radicchio, Rhubarb, Spinach and Swiss Chard	2-4 oz/100 lbs seed
Legume Vegetables (Succulent or Dried) [Crop Group 6]	Bean (Lupinus) (includes grain lupin, sweet lupin, white lupin, and white sweet lupin); bean (Phaseolus) (includes field bean, kidney bean, lima bean, navy bean, pinto bean, runner bean, snap bean, tepary bean, wax bean); bean (Vigna) (includes adzuki bean, asparagus bean, blackeyed pea, catjang, Chinese longbean, cowpea, crowder pea, moth bean, mung bean, rice bean, southern pea, urd bean, yardlong bean); broad bean (fava); chickpea (garbanzo); guar; jackbean; lablab bean; lentil; pea (Pisum) (includes dwarf pea, edible-podded pea, English pea, field pea, garden pea, green pea, snowpea, sugar snap pea); pigeon pea; soybean; soybean (immature seed); sun hemp; sword bean	2-4 oz/100 lbs seed
Oilseed Crops [Crop Group 20]	Rapeseed, canola, sunflower, safflower, flax seed, cottonseed, sesame, borage, calendula, castor oil plant, crambe, cuphea, echium, euphorbia, evening primrose, gold of pleasure, hare's ear mustard, jojoba, lesquerella, lunaris, meadowfoam, milkweed, mustard seed, niger seed, rose hip, oil radish, poppy seed, stokes aster, sweet rocket, tallowwood, tea oil plant, Vernonia	2-4 oz/100 lbs seed
Peanut		2-4 oz/100 lbs seed
Root and Tuber Vegetables [Crop Group 1]	Arracacha, Arrowroot, Artichoke, Black Salsify, Canna, Carrot, Cassava, Celeriac, Chayote Root, Chervil, Chicory, Chufa, Chinese Artichoke, Dasheen, Edible Burdock, Garden Beet, Ginger, Ginseng, Horseradish, Leren, Jerusalem Artichoke, Oriental Radish, Parsnip, Potatoes, Radish, Rutabaga, Salsify, Skirret, Spanish Salsify, Sugar Beet, Sweet Potatoes, Tumeric, Turnip, Turnip-rooted Chervil, Turnip-rooted Parsley and Yams	2-4 oz/100 lbs seed
Sugarcane		2-4 oz/100 lbs seed

Tobacco		2-4 oz/100 lbs seed
Tree Nurseries	Christmas trees, Fir, Pine, Oak, Spruce, Noble Fir, Scotch Pine, Balsam Fir, Douglas-Fir, Elm, Ash, Hickory, Poplar, Cedar, Holly, Locust, and other tree varieties for commercial use or reforestation	2-4 oz/100 lbs seed
Turfgrass	Residential Lawns, Commercial Lawns, Ornamental lawns, athletic fields, golf courses, sod farms	1-2 oz/100 lbs seed
Tropical and Subtropical Fruit, Edible Peel [Crop Group 23]	Acai, Acerola, Achachairu, African plum, Agritos, Almondette, Apak palm, Appleberry, Araza, Arbutus berry, Babaco, Bacaba palm, Bacaba-de-leque, Bayberry, Bignay, Bilimbi, Borojo, Breadnut, Cabeluda, Cajou, Cambuca, Carandas-plum, Carob, Cashew apple, Ceylon iron wood, Ceylon olive, Cherry-of-the-Rio-Grande, Chinese olive, Chirauli-nut, Ciruela verde, Cocoplum, Date, Davidson's plum, Desert-date, Doum palm coconut, False sandalwood, Feijoa, Fig, Fragrant manjack, Gooseberry, Governor's plum, Grumichama, Guabiroba, Guava, Guayabillo, Illawarra plum, Imbe, Imbu, Indian-plum, Jaboticaba, Jamaica-cherry, Jambolan, Jelly palm, Jujube, Kaffir-plum, Kakadu plum, Kapundung, Karanda, Kwai muk, Lemon aspen, Mangaba, Marian plum, Mombin, Monkeyfruit, Monos plum, Mountain cherry, Nance, Natal plum, Noni, Olive, Papaya, Pataua, Peach palm, Persimmon, Pitomba, Plum-of-Martinique, Pomerac, Rambai, Rose apple, Rukam, Rumberry, Sea grape, Sentul, Sete-capotes, Silver aspen, Starfruit, Surinam cherry, Tamarind, Uvalha, Water apple, Water pear, Water berry, Wax jambu	2-4 oz/100 lbs seed
Tropical and Subtropical Fruit, Inedible Peel [Crop Group 24]	Abiu, Aisen, Akee apple, Atemoya, Avocado, Bacury, Bael fruit, Banana, Binjai, Biriba, Breadfruit, Burmese grape, Canistel, Cat's-eyes, Champedak, Cherimoya, Cupuacu, Custard apple, Dragon fruit, Durian, Elephant apple, Etambe, Granadilla, Ilama, Inga, Jackfruit, Jatoba, Karuka, Kei apple, Langsat, Lanjut, Longan, Lucuma, Lychee, Mabolo, Madras-thorn, Mammy-apple, Manduro, Mango, Mangosteen, Marang, Marmaladebox, Matisia, Mesquite, Mongongo, Monkey-bread-tree, Monstera, Nicobar-breadfruit, Paho, Pandanus, Papaya, Passionflower, Passionfruit, Pawpaw, Pelipisan, Pequi, Pequia, Persimmon, Pineapple, Pitahaya, Pitaya, Plantain, Pomegranate, Poshte, Prickly pear, Pulasan, Quandong, Rambutan, Saguaro, Sapodilla, Sapote, Sataw, Satinleaf, Screw-pine, Sierra Leone-tamarind, Soncoya, Soursop, Spanish lime, Star apple, Sugar apple, Sun sapote, Tamarind-of-the-Indies, Velvet tamarind, Wampi, White star apple, Wild loquat	2-4 oz/100 lbs seed
Herbs and Spices [Crop Groups 19, 25, 26]	Allspice, Angelica, Anise, Star Anise, Annatto, Balm, Basil, Borage, Burnet, Camomile, Caper buds, Caraway, Cardamom, Cassia (buds and bark), Catnip, Celery seed, Chervil, Chive, Cinnamon, Clary, Clove buds, Coriander, Cilantro, Costmary, Culantro, Cumin, Curry, Dill, Fennel, Fenugreek, Grains of Paradise, Horehound, Hyssop, Juniper berry, Lavender, Lemongrass, Lovage, Mace, Marigold, Marjoram, Mint, Mustard, Nasturtium, Nutmeg, Oregano, Parsley, Pennyroyal, Pepper (white and black), Peppermint, Rosemary, Rue, Saffron, Sage, Savory, Spearmint, Sweet bay, Tansy, Tarragon, Thyme, Vanilla, Wintergreen, Woodruff, Wormwood	2-4 oz/100 lbs seed
Stalk, Stem, and Leaf Petiole Vegetables [Crop Group 22]	Agave, Aloe Vera, Asparagus, Bamboo shoots, Cardoon, Celery, Celtuce, Fennel, Fern, Fuki, Kale, Kohlrabi, Palm hearts, Prickly pear, Rhubarb, Udo, Zuiki	2-4 oz/100 lbs seed
Hops		2-4 oz/100 lbs seed

{Note to Reviewer: Text in [brackets] is optional or alternate wording. Text in {braces} is information and may not appear on final commercial label.}

Nongrass Animal Feeds [Crop Group 18]	Alfalfa, Velvet Bean, Clover, Lespedeza, Lupin, Sainfoin, Trefoil, Vetch (crown and milk), Bahia grass (*Paspalum spp.*)	1-2 oz/100 lbs seed

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.
Pesticide Storage: Store in a cool dry place. Avoid freezing.
Pesticide Disposal: To avoid wastes, use all material in this container by application according to label directions. If wastes cannot be avoided, offer remaining product to a waste disposal facility or pesticide disposal program.
Container Handling:
{for containers equal to or less than 5 gallons}
Nonrefillable container. Do not reuse or refill this container. Triple rinse as follows: Empty the remaining contents into application equipment or mix tank and drain for 10 seconds after the flow begins to drip. Fill the container 1/4 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 if available, or puncture and dispose of in a sanitary landfill or by incineration. Do not burn unless allowed by state and local ordinances.

{for containers over 5 gallons}
Non-refillable container. Do not reuse or refill this container. Triple rinse container as follows: Empty the remaining contents into application equipment or a mix tank. Fill the container 1/4 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 more times. Then offer for recycling if available, or puncture and dispose of in a sanitary landfill or by incineration. Do not burn unless allowed by state and local ordinances.

NOTICE ON CONDITIONS OF SALE

By using this product, user or buyer accepts the following Conditions, Disclaimer of Warranties and Limitations of Liability.

CONDITIONS: The directions for use of this product are believed to be adequate and must be followed carefully. However, it is impossible to eliminate all risks associated with the use of this product. Crop injury, ineffectiveness or other unintended consequences may result because of such factors as weather conditions, presence of other materials, or the manner of use or application, all of which are beyond the control of Seller. All such risks shall be assumed by the user or buyer.

DISCLAIMER OF WARRANTIES: To the extent consistent with applicable law, Seller makes no other warranties, express or implied, of merchantability or of fitness for a particular purpose or otherwise, that extend beyond the statements made on this label. No agent of Seller is authorized to make any warranties beyond those contained herein or to modify the warranties contained herein. To the extent consistent with applicable law, Seller disclaims any liability whatsoever for special, incidental or consequential damages resulting from the use or handling of this product.

LIMITATIONS OF LIABILITY: To the extent consistent with applicable law, the exclusive remedy of the user or buyer for any and all losses, injuries or damages resulting from the use or handling of this product, whether in contract, warranty, tort, negligence, strict liability or otherwise, shall not exceed the purchase price paid or at Seller election, the replacement of product.

{May be printed directly on container} [Batch][Lot] No._____

[Optional marketing claims]

- [Made] [Manufactured] in [the] U.S.A. [Flag Image]
- Biopesticide
- Bio-nematicide
- Bio-nematostat
- Protects against nematodes
- For Control/Suppression of Nematodes
- Not for sale (or use) in California
- Nemasan is a novel nematicide formulation made from specialized ingredients
- Apply to Turf, Fruit, Vegetables, Ornamentals, and Row Crops
- Nematode Suppression/Control
- Low Usage Rate
- Visit our website for more details!
- Nemasan.com
- Organisancorp.com
- This product may be applied as often as and as many times as necessary (to maintain control) (of target pests)
- Nemasan Benefits (NOTE: as a header to list other claims)
- Effective Nematode suppression/control
- No special application equipment [required]
- [Nemasan] [Product] Can be applied with your standard spray regimen
- No special spray protocol required
- Not crop specific
- Apply at any time [in] [during] [the] growing season
- Apply anytime
- Spray any time in crop cycle
- Apply foliar or fertigation
- REI of 4 hours (EPA Minimum)
- Packaged in 2.5 gallon jug, 275 gallon tote and bulk tanker
- For the protection of turfgrass (including sod farms) against damage caused by certain plant pathogenic nematodes.
- Broad spectrum control of nematodes
- Reduces populations of plant pathogenic nematodes
- Effective [early-season] control of listed insects
- Effective against aphids, thrips, psyllids, mealy bugs, leaf miners, beetles, whiteflies and other listed insects
- Effective insect control
- Suppresses insect populations
- Effective against Fusarium, Phytophthora, rots, molds, and listed crop and turf diseases
- Effective control of listed [plant diseases] [foliar [fungi/pathogens]] [soil [fungi/pathogens]]
- Effective [foliar] disease control
- Suppresses disease prevalence
- Enhanced leaf color and turf density in the presence of plant pathogenic nematodes [and fungal diseases]
- For protection against damage caused by certain plant pathogenic nematodes [and fungal diseases] [on turf and ornamentals]
- Safe to use around honey bees
- The Nematicide you have been waiting for!
- Are you fighting nematode hot spots? Try Nemasan!
- It works fast
- No respirator [required] [for application]

- Minimal PPE required to apply
- Spray over the top of this with anything!
- [For optimal results,] Organisan Corporation recommends [its adjuvant] Enhan-cer 2 and OII-YS from the O2YS Corporation. Both adjuvants have been specifically formulated for use with Nemasan [Product Name] [this product]
- Promotes the ability of plants to defend against fungal infections
- Increases germination rates
- Improves seed vitality
- Improves sprouting efficiency and vigor
- Promotes a stronger emergence
- Increases root bio-mass
- Seeds and seedlings start with incorporated chitosan leading to chitosan promoting healthier plants from the outset
- Young seedlings are healthier and can resist disease and pathogens
- [Generally] improves plant vigor
- Stimulates plant defense mechanisms
- Stimulates systemic resistance [against listed pathogens and disease]
- Activates innate immunity within the plant [from the outset of germination]
- Elevates defense response mechanisms in plants
- Promotes increased populations of soil microflora and beneficial microbes
- Effectively boosts plant resistance [against listed pathogens and disease]
- Shortens the time required for expression of mature plant resistance
- Triggers the defensive mechanisms in plants for better production
- Reducing nematode feeding, movement, reproduction and hatching.
- Effective fast acting control
- Reliable systemic control
- Works above and below ground
- Controls and suppresses nematodes
- Prevents nematodes from attacking roots
- Increases availability of nutrients in the soil
- Seed coating offers immediate protection to the seed and emerging seedling
- Stabilizes seed in storage by creating a barrier of protection
- Promotes more vigorous seedling root growth [establishment] and plant growth
- Can be used at pre planting, transplanting, post planting at any time in the growth cycle up to preharvest according to label instructions
- Protects root hairs
- [Product Name] has two active ingredients, chitosan and quillaja.
- chitosan and quillaja act synergistically.
- Chitosan is a polymer similar to cellulose. Chitosan acts in two ways with seed treatment while the seed is being coated, some of the chitosan is imbibed through the seed coat. This fortifies the seed in many ways
- Seal endosperm to inhibit desiccation.
- Stimulates germinating seed to produce phytoalexins for increased seed health in new seedlings.
- Stimulates newly emerged seedlings to increase chlorophyll content.
- Stimulates newly emerged seedlings to increase chitinase production for increased antifeedants against insects.
- Helps to control stomata openings in newly emerged seedlings for transpiration control.
- Residual chitosan on the seed surface is also active
- Improves adhesion of additional seed treatment compounds.
- Stimulates and increases microbial activity in soil adjacent to the treated seed.
- Provides protection against seed borne diseases and newly emerged seedlings.
- Provides improved seed handling flow during planting to inhibit sticking or clumping together of seed.
- Helps prevent damage to seed coat during handling, storage, and planting.

- Provides nematode suppression.
- Quillaja is an extract containing natural surfactants called saponins.
- Quillaja saponins also act in two main ways in [Product Name]
- Surfactant nature lowers surface tension and facilitates chitosan being imbibed
- Quillaja saponins have known nematicidal, fungicidal and larvicidal properties.
- Residual quillaja on the surface can leach into the immediate soil environment at planting affording valuable protection. Working in concert with the chitosan
- Quillaja also shown to enhance germination rates
- Imbibes thru the seed coat to seal endosperm to inhibit desiccation.
- Stimulates germinating seed to produce phytoalexins for increased seed health in new seedlings.
- Stimulates newly emerged seedlings to increase chlorophyll content.
- Stimulates newly emerged seedlings to increase chitinase production for increased antifeedants against insects.
  Helps to control stomata openings in newly emerged seedlings for transpiration control.
- Improves adhesion of additional seed treatment compounds.
- Stimulates and increases microbial activity in soil adjacent to the treated seed.
- Provides protection against seed borne diseases and newly emerged seedlings.
- Provides improved seed handling flow during planting to inhibit sticking or clumping together of seed.
- Helps prevent damage to seed coat during handling, storage, and planting.
- Provides nematode, listed insect/ plant pest suppression.
- When used as directed on this label, [this product] [Product Name] can boost seed germination and vitality, stimulate emergence and sprouting, enhance plant vigor, promote root growth, promote foliar growth, increase crop yields, improve crop vigor and quality, suppress diseases and pathogens, activate plant resistances to environmental stress, drought, and disease pressures, including the suppression of plant parasitic nematodes and listed insects.
- [This product] [Product name] Protects field crops, ornamentals, trees, citrus, grasses, grains, legumes, fruits, and vegetables against *Pythium, Rhizoctonia, Fusarium,* stem wilt, damp-off, early blight, late blight, and mold.
- [This product] [Product name] Protects ornamentals, field crops, trees, grasses, grains, legumes, fruits, citrus, turf and sod, and vegetables.
- For use on tropical plants, grasses, pine and deciduous trees, shrubs, ground covers, bedding plants, house plants, herbs, vegetables, fruits, citrus, turf and sod, and flowers.
- Bio-fungicide
- Sustainably sourced ingredients
- Great addition to fungicidal rotations
- No annual use max rate concerns
- Fight nematodes, plant pathogens, insect pests simultaneously
- Effective, alternative fungicide
- Great addition to insecticidal rotations
- Great addition to nematode control rotations
- Images of target pest (i.e. nematode) with circle-backslash symbol (no sign, prohibition sign)

OFFICE OF CHEMICAL SAFETY AND POLLUTION PREVENTION

WASHINGTON, D.C. 20460

March 31, 2025

Jeffrey Currie
jcurrie@springregulatory.com
TIDAL VISION PRODUCTS INC.

Subject: Non-PRIA (Pesticide Registration Improvement Act) Labeling Amendment - Revision to label to update optional images
Product Name: GenMax
Admin Number: 93966-1
EPA Receipt Date: 01/23/2025
Action Case Number: 00649537

Dear Jeffrey Currie:

The amended labeling referred to above, submitted in connection with registration under the Federal Insecticide, Fungicide, and Rodenticide Act, as amended, is acceptable.

This approval does not affect any terms or conditions that were previously imposed on this registration. You continue to be subject to existing terms or conditions on your registration and any deadlines connected with them.

A stamped copy of your labeling is enclosed for your records. This labeling supersedes all previously accepted labeling. You must submit one (1) copy of the final printed labeling before you release this product for shipment with the new labeling. In accordance with 40 CFR § 152.130(c), you may distribute or sell this product under the previously approved labeling for 18 months from the date of this letter. After 18 months, you may only distribute or sell this product if it bears this new revised labeling or subsequently approved labeling. “To distribute or sell” is defined under FIFRA section 2(gg) and its implementing regulation at 40 CFR § 152.3.

Should you wish to add/retain a reference to your company’s website on your label, then please be aware that the website becomes labeling under FIFRA and is subject to review by EPA. If the website is false or misleading, the product will be considered to be misbranded and sale or distribution of the product is unlawful under FIFRA section 12(a)(1)(E). 40 CFR § 156.10(a)(5) lists examples of statements the EPA may consider false or misleading. In addition, regardless of whether a website is referenced on your product’s label, claims made on the website may not substantially differ from those claims approved through the registration process. Therefore, should the EPA find or if it is brought to our attention that a website contains statements or claims substantially differing from statements or claims made in connection with obtaining a FIFRA section 3 registration, the website will be referred to the EPA’s Office of Enforcement and Compliance Assurance.

Your release for shipment of this product constitutes acceptance of these terms. If these terms are not complied with, this registration will be subject to cancellation in accordance with FIFRA section 6.

If you have questions, please contact Menyon Adams via email at adams.menyon@epa.gov.

Sincerely,

James Parker, Team Leader
BPB, BPPD
Office of Pesticide Programs

Master Label containing:
Sublabel A: Agricultural Seed and In-Furrow Treatment Use
Sublabel B: Field, Nursery, and Ornamental Use
Sublabel C: Home & Garden Use

ACCEPTED
ONLY INDICATED
REVISIONS REVIEWED
03/31/2025
Under the Federal Insecticide, Fungicide and Rodenticide Act as amended, for the pesticide registered under EPA Reg. No.
93966-1
No label revisions other than those indicated were reported to the Agency.

GenMax®

Agricultural, Ornamental, Nursery and Home & Garden Use

[ABN: GenMax® OS, Tidal Grow® OS, GenMax® ST, Tidal Grow® ST,Tidal Grow® Protech'd, Tidal Grow® Cover, Tidal Grow® Bloom, Tidal Grow® GH, GenMax® GH, Tidal Grow® T&O, GenMax® T&O, GenMax® H&G, Tidal Grow® H&G, GenMax® HG, Tidal Grow® HG, Tidal Grow® Home, GenMax® Home, Tidal Grow® Garden, GenMax® Garden, GenMax® ST Gold, GenMax® ST Ultra, Gen Max® ST Next ,GenMax® OS Gold, GenMax® OS Ultra, Gen Max® OS Next]

[Refer to Accompanying Label Booklet for Complete Use Directions]

ACTIVE INGREDIENT:

Chitosan..... 0.25%

OTHER INGREDIENTS: 99.75%

Total 100.00%

Product contains 0.021 lb (0.01 kg) for chitosan/gallon

KEEP OUT OF REACH OF CHILDREN

CAUTION

SEE SIDE/INSIDE/BACK PANEL FOR FIRST AID AND PRECAUTIONARY STATEMENTS

EPA Reg. No. 93966-1

EPA Est. No. _____

MANUFACTURED FOR:
Tidal Vision Products, Inc. DBA Tidal Grow AgriScience
3710 Iron Gate Rd.
Bellingham, WA 98225

Sublabel A: Agricultural Seed Treatment and In-Furrow Use

GenMax®

Agricultural Use

[ABN: GenMax® OS, Tidal Grow® OS, GenMax® ST, Tidal Grow® ST, GenMax® ST Gold, GenMax® ST Ultra, Gen Max® ST Next ,GenMax® OS Gold, GenMax® OS Ultra, Gen Max® OS Next]

When used as directed, GenMax can boost seed germination and vitality, stimulate emergence and sprouting, enhance plant vigor, promote root and foliar growth, increase crop yields, improve crop vigor and quality, protect against diseases and pathogens, activate plant resistances to environment stress, drought, and disease pressures, including protection against plant parasitic nematodes and insect pests.

[GenMax protects against insects, nematodes, bacterial diseases, and fungal diseases by both direct pathogen/pest control and induced systemic resistance.]{All or some of the pests and pathogens listed in this section may be included in the market label}

[For use on corn, canola, soybeans, rice, sugar cane, sugarbeets, vegetables, herbs, sunflowers, wheat, grains, cereals, legumes, and flowers.]{All or some of the listed crops in this section may be included in the market label}

ACTIVE INGREDIENT:

Chitosan	0.25%
OTHER INGREDIENTS:	99.75%
Total	100.00%

Product contains 0.021 lb (0.01 kg) for chitosan/gallon

KEEP OUT OF REACH OF CHILDREN

CAUTION

SEE SIDE/INSIDE/BACK PANEL FOR FIRST AID AND PRECAUTIONARY STATEMENTS

MANUFACTURED FOR:

Tidal Vision Products, Inc. DBA as Tidal Grow AgriScience
3710 Iron Gate Rd.
Bellingham, WA 98225

EPA Reg. No. 93966-1
EPA Est. No. _____
Net Contents: _____

FIRST AID	
IF IN EYES:	● Hold eye open and rinse slowly and gently with water 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 treatment advice.
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 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 product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-800-222-1222 for emergency medical treatment information	

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION: Causes moderate eye irritation. Avoid contact with eyes. Wash thoroughly with soap and water after handling.

ENVIRONMENTAL HAZARDS

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 cleaning equipment or disposing of equipment wash waters.

[For 5 gallon product: Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans, or public waters unless in accordance with the requirements of 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 into sewer without previously notifying the sewage treatment plant authority. For guidance, contact your State Water board or regional Office of the EPA.]

PERSONAL PROTECTIVE EQUIPMENT (PPE)
Applicators, mixers, loaders and other handlers must wear: Long-sleeved shirt and long pants, waterproof gloves, protective eyewear, and shoes plus socks. Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables, use detergent and hot water. Keep and wash PPE separately from other laundry.

DIRECTIONS FOR USE

It is a violation of federal laws to use this product in a manner inconsistent with its labeling.

To prevent contamination of the dilute solutions of GenMax by possible pesticide or other chemical residues in the spraying equipment, use dedicated equipment, or be sure that the equipment is thoroughly clean before use.

FOR AGRICULTURAL USE

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. For any requirements specific to your State or Tribe, consult the agency responsible for pesticide regulation.

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 interval. 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.

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
- Waterproof gloves
- Protective eyewear, and
- Shoes plus socks

TARGET PESTS

GenMax is effective against the following nematode, insect, and plant disease pests:

[Nematode Pests: Gall nematode (Anguina spp.), Guava nematode (Meloidogyne spp.),Lance nematode Hoplolaimus spp., Potato cyst nematode (Globodera spp.), Reniform nematode (Rotylenchulus spp.), Root-knot nematode (Meloidogyne spp.), Root-lesion nematode (Pratylenchus spp.), Soybean Cyst Nematode (Heterodera spp.), Spiral nematode Helicotylenchus spp, Stem nematode (Ditylenchus spp.), Sting nematode (Belonolaimus spp.)

Fungal and Bacterial Diseases: Alternaria, Anthracnose, Armillaria Root Rot, Ascochyta, Aspergillus spp., Bacterial Blast, Bacterial Soft Rot, Bacterial Spot, Blossom Blight (Monilinia spp.), Black Spot, Botrytis, Blue Mold, Brown Patch, Cercospora Leaf Spot, Charcoal Rot (macrophomina phaseolina), Citrus Canker, Coryneum Blight, Crown Rot, Curvularia, Downy Mildew, Erwinia amylovora, Fairy Ring, Fusarium spp. (*F. oxysporum, F. solani, F. graminearum, F. verticillioides*), Greasy Spot, Garlic and Onion White Rot, Goss Wilt (Clavibacter michiganensis), Gray Leaf Spot, Gray Mold. Leaf Spot, Melanose, Mummy Berry, Onion Pink Root Rot, Phomopsis, Phyllachora spp., Phytophthora spp., Phytophthora gummosis, Phytophthora Root Rot, Pythium spp., Powdery Mildew, Pseudomonas spp., Rhizoctonia spp. (*R. solani*), Septoria, Sooty Mold, Tilletia spp., Ustilago spp. Xanthomonas, Venturia inaequalis, Verticillium

Insect Pests: Aphids (all life stages except adult), Borers (all life stages),Bean Leaf Beetle, Cereal Leaf Beetle, Colorado Potato Beetle, Corn Borers (egg, larvae), Corn Ear Worm (all life stages except adult),

Corn Root Maggot (all life stages except adult), Corn Root Worm (egg, larvae instars), Crickets (egg, larvae), Grasshoppers (egg, nymph), Hessian Fly, Leaf Miners, Mealy Bugs, Mites (all life stages except adult), Pea Weevils (all life stages except adult), Pine Beetles, Plant Bugs (egg, nymph), Psyllids (egg, all 5 instar stages), Seed corn Maggot, Slugs (all life stages), Snails (all life stages), Southern Cowpea Weevil (egg, larvae, maggot), Stink Bugs (egg, nymph), Sugarcane Aphids (all life stages except adult), Thrips (egg, larvae, pre-pupal, pupal), White flies (egg, nymph), Wireworms (egg, larvae)]{All or some of the pests and pathogens listed in this section may be included in the market label}

GENERAL INSTRUCTIONS

Shake before using. Following specific crop instructions for dilution rates and application usage. Do not apply within three days of harvesting. For best results use a slurry with a pH of 7 or less. It is recommended to conduct a compatibility test with the other seed treatments intended to be used in the same blend prior to mixing full treatment volumes.

Crops	**Mixing and Application Instructions**
Seed Treatment Legumes (such as Broad Beans, Chickpeas, dry edible, Cowpeas, Guar bean, Lentils, Lima, Peas, Pigeon Peas, snap, soybeans, various, *Cicer arietinum*, *Lupinus* spp. beans, *Phaseolus* spp. Beans, *Vigna* spp. Beans), Canola, Cantaloupe, Corn (field, sweet and pop), Cotton, Flax, Grass grown for seed, Legumes (including alfalfa and clover), Ornamental flower crops, Peanuts, Safflower, Small grains (including wheat, oats, rye, barley, rice, millet, sorghum, triticale), Soybeans, Sugar Cane, Sugarbeet, Sunflowers, Tobacco, Turfgrass, Fruiting Vegetables (Bell Pepper, Tomato), Vegetables (including Asparagus, Broccoli, Brussels sprouts, Carrots, Cabbage, Cauliflower, Celery, Cucumber, Eggplants, Garlic, Head Lettuce, Leaf Lettuce, Leafy Greens, Onion, Pumpkin, Radish, Spinach, Squash), Cucurbit Vegetables (Watermelon, muskmelon, squash)	For seed treatment, Apply 0.1—1.2 fluid ounces of product per 100 lbs. seed. Apply as a water based slurry through standard slurry or mist-type commercial seed treatment equipment. May be applied with other registered seed treatment products if compatibility is known.
Seed Piece Treatment Potato Sweet potato Yam	For seed piece treatment, Apply 0.1—1.2 fluid ounces of product per 100 lbs. seed pieces. Apply as a water based slurry through standard slurry or mist-type commercial seed treatment equipment. May be applied with other registered seed treatment products if compatibility is known.
In-Furrow	Apply in-furrow at a rate of 0.85—6 fl. oz. per

Peanuts, Cotton, Corn (field, sweet, pop), Potatoes, Leafy Vegetables (petiole), Leafy Greens, Brassicas, Root Vegetables, Sugarbeets	acre.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

PESTICIDE STORAGE: Store in original container in a cool, dry place away from sunlight and out of the reach of children and pets. Do not reuse container.

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: Nonrefillable container. Do not reuse or refill this container. Offer for recycling, if available. Triple rinse or pressure rinse container (or equivalent) promptly after emptying. (For product less than 5 gallons) 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 1/4 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. (For product greater than 5 gallons) Triple rinse as follows: Empty the remaining contents into application equipment or a mix tank. Fill the container 1/4 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 more times. An empty container retains vapor and product residue. Observe label safeguards until container is cleaned, reconditioned or destroyed. Completely empty contents into formulation equipment. Then offer for recycling or reconditioning or, dispose of container in a manner approved by state and local authorities.

WARRANTY

Tidal Vision Products, Inc. warrants that this product conforms to the chemical description on the label thereof and is reasonably fit for purposes stated on such label only when used in accordance with directions under normal use conditions. It is impossible to eliminate all risks inherently associated with use of this product. Crop injury, ineffectiveness or other unintended consequences may result because of such factors as weather conditions, presence of other materials or the manner of use or application, all of which are beyond the control of Tidal Vision Products, Inc. To the extent consistent with applicable law, Tidal Vision Products, Inc. shall not be liable for consequential, special or indirect damages resulting from the use or handling of this product. All such risks shall be assumed by the Buyer. To the extent consistent with applicable law, the exclusive remedy of any buyer or user of this product for any and all losses, injuries, or damages resulting from or in any way arising from the use, handling, or application of this product, whether in contract, warranty, tort, negligence, strict liability, or otherwise, shall not exceed the purchase price paid for this product or at Tidal Vision Products, Inc. election, the replacement of this product. Tidal Vision Products, Inc. MAKES NO WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR ANY OTHER EXPRESS OR IMPLIED WARRANTY EXCEPT AS STATED ABOVE.

Manufactured For:
Tidal Vision Product, Inc. DBA Tidal Grow AgriSciences
3710 Iron Gate Rd
Bellingham, WA 98226

Sublabel B: Field, Nursery, and Ornamental Use

GenMax®

Field, Nursery, and Ornamental Use

[ABN: Tidal Grow® Protech'd, Tidal Grow® Cover, Tidal Grow® Bloom, Tidal Grow® GH, GenMax® GH, Tidal Grow® T&O, GenMax® T&O, GenMax® ST Gold, GenMax® ST Ultra, Gen Max® ST Next, GenMax® OS Gold, GenMax® OS Ultra, GenMax® OS Next, GH Max]

When used as directed, GenMax can boost seed germination and vitality, stimulate emergence and sprouting, enhance plant vigor, promote root and foliar growth, increase crop yields, improve crop vigor and quality, protect against diseases and pathogens, activate plant resistances to environment stress, drought, and disease pressures, including protection against plant parasitic nematodes and insect pests.

[GenMax protects against insects, nematodes, bacterial diseases, and fungal diseases by both direct pathogen/pest control and induced systemic resistance.]{All or some of the pests and pathogens listed in this section may be included in the market label}

[GenMax protects field crops, ornamentals, trees, citrus, grasses, grains, legumes, fruits and vegetables against pests and diseases such as nematodes, wireworm, diamondback moth, mites, thrips, aphids, Phytophthora, Anthracnose, Fusarium, Coleoptera, Phomopsis, Alternaria, Rhizoctonia, Botrytis, Monilinia, Macrophomina, Sclerotinia, Cladosporium, Colletotrichum, Verticillium, Erwinia, Xanthomonas, Pseudomonas, Clavibacter, Agrobacterium, Potato Virus X, and Mosaic viruses.] {All or some of the listed crops, pests, and diseases in this section may be included in the market label}

ACTIVE INGREDIENT:

Chitosan 0.25%

OTHER INGREDIENTS: 99.75%

Total 100.00%

Product contains 0.021 lb (0.01 kg) for chitosan/gallon

KEEP OUT OF REACH OF CHILDREN

CAUTION

SEE SIDE/INSIDE/BACK PANEL FOR FIRST AID AND PRECAUTIONARY STATEMENTS

MANUFACTURED FOR:

Tidal Vision Products, Inc. DBA as Tidal Grow AgriScience
3710 Iron Gate Rd.
Bellingham, WA 98225

EPA Reg. No. 93966-1
EPA Est. No. _____
Net Contents: _____

FIRST AID	
IF IN EYES:	• Hold eye open and rinse slowly and gently with water 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 treatment advice.
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 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 product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-800-222-1222 for emergency medical treatment information	

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION: Causes moderate eye irritation. Avoid contact with eyes. Wash thoroughly with soap and water after handling.

ENVIRONMENTAL HAZARDS

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 cleaning equipment or disposing of equipment wash waters.

[For 5 gallon product: Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans, or public waters unless in accordance with the requirements of 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 into sewer without previously notifying the sewage treatment plant authority. For guidance, contact your State Water board or regional Office of the EPA.]

PERSONAL PROTECTIVE EQUIPMENT (PPE)
Applicators, mixers, loaders and other handlers must wear: Long-sleeved shirt and long pants, waterproof gloves, protective eyewear, and shoes plus socks. Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables, use detergent and hot water. Keep and wash PPE separately from other laundry.

DIRECTIONS FOR USE

It is a violation of federal laws to use this product in a manner inconsistent with its labeling.

To prevent contamination of the dilute solutions of GenMax by possible pesticide or other chemical residues in the spraying equipment, use dedicated equipment, or be sure that the equipment is thoroughly clean before use.

Non-Agricultural Use Requirements
The requirements in this box apply to uses of this product that are not within the scope of the Worker Protection Standard for agricultural pesticides (40 CFR Part 170). The WPS applies when this product is used to produce agricultural plants on farms, forests, nurseries or greenhouses. Keep people and pets of

treated areas until spray solution has dried to prevent transfer of this product onto desirable vegetation.

[TARGET CROPS

Roots/Tubers (such as cassava, potatoes, sweet potatoes, and yams)**, Vegetables** (such as Artichokes, Broccoli, Brussels sprouts, Cabbage, Carrots, Cauliflower, Cucumber, Eggplants, Garlic, Leafy Vegetables, Onion, Pumpkin, Squash)**, Legumes** (such as Broad Beans, Chickpeas, Lentils, Peas, Pigeon Peas, soybeans, various *Lupinus* spp. beans, *Phaseolus* spp. Beans, *Vigna* spp. Beans)**, Citrus Fruits** (such as Grapefruits, Limes, Lemons, Oranges), **Pome Fruits** (such as Apples, Crabapples, Loquats, Pears, Oriental Pears, Quinces)**, Stone Fruits** (such as Apricots, Sweet Cherries, Tart Cherries, Nectarines, Peaches, Plums, Prunes)**, Berries & Small Fruits** (such as Aronia Berries, Blackberries, Blueberries, Currants, Elderberries, Gooseberries, Grapes, Huckleberries, Kiwifruits, Loganberries, Mulberries, Raspberries, Strawberries)**, Tree Nuts** (such as Almonds, Beech Nuts, Brazil Nuts, Butternuts, Cashews, Chestnuts, Hazelnuts, Hickory Nuts, Macadamia Nuts, Pecans, Walnuts)**, Forage/Fodder/Straw of Cereal Grains** (such as Corn, Wheat, and any other cereal grains)**, Grass Forage/Fodder/Hay** (such as Bermuda Grass, Bluegrass, Bromegrass, Fescue)**, Nongrass Animal Feeds** (such as Alfalfa, Velvet Bean, Clover, Kudzu, Lespedeza, Lupin, Sainfoin, Trefoil, Vetch)**, Herbs & Spices** (such as Allspice, Anise, Annatto, Basil, Borage, Caraway, Cardamom, Celery Seed, Chive, Cinnamon, Coriander, Cilantro, Cumin, Dill, Fennel, Fenugreek, Lagvender, Lemongrass, Mustard, Black Pepper, Rosemary, Sage, Savory, Tarragon, Thyme, etc.)**, Oilseed** (such as Castor, Cottonseed, Flax Seed, Rapeseed, Safflower, Sesame, Sunflower, etc.)**, Tropical Fruits** (such as Açaí, Acerola, Avocado, Banana, Carob, Date, Dragon Fruit, Durian, Fig, Guava, Jackfruit, Lychee, Mango, Olive, Papaya, Passion Fruit, Persimmon, Pineapple, Pomegranate, Rambutan, Soursop, Star Fruit, etc.), **Turf & Ornamentals, Flowering plants.]{**All or some of the listed crops in this section may be included in the market label}

TARGET PESTS

GenMax is effective against the following nematode, insect, and plant disease pests:

[Nematode Pests: Gall nematode (Anguina spp.), Guava nematode (Meloidogyne spp.), Potato cyst nematode (Globodera spp.), Reniform nematode (Rotylenchulus spp.), Root-knot nematode (Meloidogyne spp.), Root-lesion nematode (Pratylenchus spp.), Soybean Cyst Nematode (Heterodera spp.), Stem nematode (Ditylenchus spp.), Sting nematode (Belonolaimus spp.)

Fungal and Bacterial Diseases: Alternaria, Anthracnose, Armillaria Root Rot, Ascochyta, Aspergillus spp., Bacterial Blast, Bacterial Soft Rot, Bacterial Spot, Black Spot, Botrytis, Blue Mold, Brown Patch, Cercospora Leaf Spot, Charcoal Rot (macrophomina phaseolina), Citrus Canker, Coryneum Blight, Crown Rot, Curvularia, Downy Mildew, Erwinia amylovora, Fairy Ring, Fusarium spp. (*F. oxysporum, F. solani, F. graminearum, F. verticillioides*), Greasy Spot, Garlic and Onion White Rot, Goss Wilt (Clavibacter michiganensis), Gray Leaf Spot, Leaf Spot, Melanose, Onion Pink Root Rot, Phomopsis, Phyllachora spp., Phytophthora spp., Phytophthora gummosis, Phytophthora Root Rot, Pythium spp., Powdery Mildew, Pseudomonas spp., Rhizoctonia spp. (*R. solani*), Septoria, Sooty Mold, Tilletia spp., Ustilago spp. Xanthomonas, Venturia inaequalis, Verticillium

Insect Pests: Aphids (all life stages except adult), Borers (all life stages),Bean Leaf Beetle, Cereal Leaf Beetle, Colorado Potato Beetle, Corn Borers (egg, larvae), Corn Ear Worm (all life stages except adult), Corn Root Maggot (all life stages except adult), Corn Root Worm (egg, larvae instars), Crickets (egg, larvae), Grasshoppers (egg, nymph), Hessian Fly, Leaf Miners, Mealy Bugs, Mites (all life stages except

adult), Pea Weevils (all life stages except adult), Pine Beetles, Plant Bugs (egg, nymph), Psyllids (egg, all 5 instar stages), Seed corn Maggot, Slugs (all life stages), Snails (all life stages), Southern Cowpea Weevil (egg, larvae, maggot), Stink Bugs (egg, nymph), Sugarcane Aphids (all life stages except adult), Thrips (egg, larvae, pre-pupal, pupal), White flies (egg, nymph), Wireworms (egg, larvae)]{All or some of the pests and pathogens listed in this section may be included in the market label}

GENERAL INSTRUCTIONS

Shake before using. For best results, check compatibility with other tank mix partners/water. Traditionally, solutions with pH lower than 7 work best. If the blend is incompatible, then adjust the pH down with acetic or citric acid to improve solubility. Follow specific crop instructions for dilution rates and application usage.

Crops	**Mixing and Application Instructions**
Seeds	For seed treatment, Apply 0.1—1 fluid ounces of product per 100 lbs. seed. Apply as a water based slurry through standard slurry or mist-type commercial seed treatment equipment. May be applied with other registered seed treatment products if compatibility is known.
Minituber, seed potato, potato	For seed piece treatment, Apply 0.1—1 fluid ounces of product per 100 lbs. seed pieces. Apply as a water-based slurry through standard slurry or mist-type commercial seed treatment equipment. May be applied with other registered seed treatment products if compatibility is known.
Field crops including corn, soybean, wheat, alfalfa, small grains, grass, sugarbeet, cotton, tobacco, and legume	<u>Irrigation</u> ● Apply 8—32 fl oz product per acre ● Can be injected into a pivot, used in drip line, or any other means of irrigation ● Use water volumes that would typically be used with your irrigation system <u>In-Furrow</u> ● Apply 0.4—4 fl oz product per acre ● Can be combined with other in-furrow products if compatibility is confirmed <u>Foliar Application</u> ● Apply 4—16 fl oz per acre ● Apply before and after emergence; apply every 30 days or as needed Apply by foliar spray and/or irrigation
Vegetables	<u>Foliar Application</u> ● Apply 4—16 fl oz per acre

	• Apply before and after emergence; apply every 30 days or as needed • Apply by foliar spray and/or irrigation
Nursery Crops- Trees & Shrubs	Apply 16—48 fl oz per acre Application rate: 500 ml to 1500 ml per acre Apply every 21 to 45 days or as needed Apply by foliar spray, drip line, and/or irrigation
Fruit Trees and Citrus	Apply 16—48 fl oz into 20 to 500 gallons or more per acre Apply every 30 days or as needed Apply by foliar spray, drip line, and/or irrigation
Turf and Sod	Apply 16—48 fl oz per acre Apply area every 21 to 45 days or as needed Apply by irrigation or surface spray
Greenhouse & Horticultural Use Ornamental Crops	Apply 0.1—7.0 fl oz product per 1000 sq ft Apply to soil and/or spray plants May be applied by means of irrigation
Transplanting	Mix 0.1 fl oz into 5 gallons or more Apply enough product to wet the soil covering transplant Apply every two weeks as needed
Compost	Mix rate: 16—48 fl oz into 50 gallons or more Apply area: 1 acre; apply every two weeks as needed May be applied by means of irrigation or spray application

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

PESTICIDE STORAGE: Store in original container in a cool, dry place away from sunlight and out of the reach of children and pets. Do not reuse container.

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: Nonrefillable container. Do not reuse or refill this container. Offer for recycling, if available. Triple rinse or pressure rinse container (or equivalent) promptly after emptying. (For product less than 5 gallons) 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 1/4 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. (For product greater than 5 gallons) Triple rinse as follows: Empty the remaining contents into application equipment or a mix tank. Fill the container 1/4 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 more times. An empty container retains vapor and product residue. Observe label safeguards until container is cleaned, reconditioned or destroyed. Completely empty contents into formulation equipment. Then offer for recycling or reconditioning or, dispose of container in a manner

approved by state and local authorities.

WARRANTY

Tidal Vision Products, Inc. warrants that this product conforms to the chemical description on the label thereof and is reasonably fit for purposes stated on such label only when used in accordance with directions under normal use conditions. It is impossible to eliminate all risks inherently associated with use of this product. Crop injury, ineffectiveness or other unintended consequences may result because of such factors as weather conditions, presence of other materials or the manner of use or application, all of which are beyond the control of Tidal Vision Products, Inc. To the extent consistent with applicable law, Tidal Vision Products, Inc. shall not be liable for consequential, special or indirect damages resulting from the use or handling of this product. All such risks shall be assumed by the Buyer. To the extent consistent with applicable law, the exclusive remedy of any buyer or user of this product for any and all losses, injuries, or damages resulting from or in any way arising from the use, handling, or application of this product, whether in contract, warranty, tort, negligence, strict liability, or otherwise, shall not exceed the purchase price paid for this product or at Tidal Vision Products, Inc. election, the replacement of this product. Tidal Vision Products, Inc. MAKES NO WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR ANY OTHER EXPRESS OR IMPLIED WARRANTY EXCEPT AS STATED ABOVE.

Manufactured For:

Tidal Vision Product, Inc. DBA Tidal Grow AgriScience
3710 Iron Gate Rd
Bellingham, WA 98225

Sublabel C: Home & Garden Use

GenMax®

Home & Garden Use

[ABN: GenMax® H&G, GenMax® HG, Tidal Grow® H&G, Tidal Grow® HG, Tidal Grow® Home, Tidal Grow® Garden, GenMax® Garden, GenMax® Home,GenMax® ST Gold, GenMax® ST Ultra, Gen Max® ST Next ,GenMax® OS Gold, GenMax® OS Ultra, Gen Max® OS Next, H&G Max]

When used as directed, GenMax can boost seed germination and vitality, stimulate emergence and sprouting, enhance plant vigor, promote root and foliar growth, increase crop yields, improve crop vigor and quality, protect against diseases and pathogens, activate plant resistances to environment stress, drought, and disease pressures, including protection against plant parasitic nematodes and insect pests.

[GenMax protects against insects, nematodes, bacterial diseases, and fungal diseases by both direct pathogen/pest control and induced systemic resistance.]{All or some of the pests and pathogens listed in this section may be included in the market label}

[GenMax protects citrus, field crops, fruits, grains, grasses, legumes, legumes, ornamentals, shrubs, trees, and vegetables against pests and diseases such as Agrobacterium, Alternaria, aphids, Anthracnose, Botrytis, Cladosporium, Clavibacter, Coleoptera, Colletotrichum, diamondback moth, Erwinia, Fusarium, Macrophomina, mites, Monilinia, Mosaic viruses, nematodes, Phomopsis, Phytophthora, Potato Virus X, Pseudomonas, Rhizoctonia, Sclerotinia, thrips, Verticillium, Xanthomonas, and wireworm.]{All or some of the pests and pathogens listed in this section may be included in the market label}

[GenMax protects pine trees against Pine Beetles, Mountain Pine Beetle and Bark Beetles.]

[For use on tropical plants, grasses, pine and deciduous trees, shrubs, ground covers, bedding plants, house plants, herbs, vegetables, fruits, citrus, turf & ornamentals.]{All or some of the pests and pathogens listed in this section may be included in the market label}

ACTIVE INGREDIENT:

Chitosan	0.25%
OTHER INGREDIENTS:	99.75%
Total	100.00%

Product contains 0.021 lb (0.01 kg) for chitosan/gallon

KEEP OUT OF REACH OF CHILDREN

CAUTION

SEE SIDE/INSIDE/BACK PANEL FOR FIRST AID AND PRECAUTIONARY STATEMENTS

MANUFACTURED FOR:

Tidal Vision Products, Inc. DBA as Tidal Grow AgriScience
3710 Iron Gate Rd.
Bellingham, WA 98225

EPA Reg. No. 93966-1
EPA Est. No. _____
Net Contents: _____

FIRST AID	
IF IN EYES:	• Hold eye open and rinse slowly and gently with water 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 treatment advice.
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 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 product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-800-222-1222 for emergency medical treatment information	

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION: Causes moderate eye irritation. Avoid contact with eyes. Wash thoroughly with soap and water after handling.

ENVIRONMENTAL HAZARDS

To protect the environment, do not allow pesticide to enter or run off into storm drains, drainage ditches, gutters or surface waters. Applying this product in calm weather when rain is not predicted for the next 24 hours will help to ensure that wind or rain does not blow or wash pesticide off the treated area. Rinsing application equipment over treated area will help avoid run off to water bodies or drainage systems.

DIRECTIONS FOR USE

It is a violation of federal laws to use this product in a manner inconsistent with its labeling.

To prevent contamination of the dilute solutions of GenMax by possible pesticide or other chemical residues in the spraying equipment, use dedicated equipment, or be sure that the equipment is thoroughly clean before use.

GENERAL INSTRUCTIONS

Shake before using. For best results, check compatibility with other tank mix partners/water. Traditionally, solutions with pH lower than 7 work best. If the blend is incompatible, then adjust the pH down with acetic or citric acid to improve solubility. Follow specific crop instructions for dilution rates and application usage.

Crops	**Mixing and Application Instructions**
Seeds	Mix 0.1—1 fl oz into 5 gallons Apply enough product to wet the soil covering seeds. Apply every week as needed
Home & Garden – Bedding	Apply 0.0035-0.18 fluid ounces of product per 1000 sq ft

Plants, Vegetables, Flowers and Ornamentals	Apply to soil and/or spray plants, apply additional water to soil as needed
Compost	Apply 0.1—10 fluid ounces May be applied by means of irrigation or sprayer Apply every two weeks or as needed
Turf and Sod	Apply 0.1—10 fluid ounces of product per 1000 sq ft Water area and spray surface area May be applied by means of irrigation or sprayer Apply every 10 days or as needed
Trees, shrubs	Mix 0.1—10 fluid ounces product into 5—10 gallons May be applied by means of sprayer, apply additional water to soil as needed Apply every 30 to 45 days or as needed to soil under the drip line

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

PESTICIDE STORAGE: Store in original container in a cool, dry place away from sunlight and out of the reach of children and pets. Do not reuse container.

PESTICIDE DISPOSAL AND CONTAINER HANDLING: Non-refillable container. **If empty:** Do not reuse or refill this container. Place in trash or offer for recycling if available. **If partly filled:** Call your local solid waste agency or 1-800-CLEANUP for disposal instructions. Never place unused product down any indoor or outdoor drain.

WARRANTY

Tidal Vision Products, Inc. warrants that this product conforms to the chemical description on the label thereof and is reasonably fit for purposes stated on such label only when used in accordance with directions under normal use conditions. It is impossible to eliminate all risks inherently associated with use of this product. Crop injury, ineffectiveness or other unintended consequences may result because of such factors as weather conditions, presence of other materials or the manner of use or application, all of which are beyond the control of Tidal Vision Products, Inc. To the extent consistent with applicable law, Tidal Vision Products, Inc. shall not be liable for consequential, special or indirect damages resulting from the use or handling of this product. All such risks shall be assumed by the Buyer. To the extent consistent with applicable law, the exclusive remedy of any buyer or user of this product for any and all losses, injuries, or damages resulting from or in any way arising from the use, handling, or application of this product, whether in contract, warranty, tort, negligence, strict liability, or otherwise, shall not exceed the purchase price paid for this product or at Tidal Vision Products, Inc. election, the replacement of this product. Tidal Vision Products, Inc. MAKES NO WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR ANY OTHER EXPRESS OR IMPLIED WARRANTY EXCEPT AS STATED ABOVE.

Manufactured For:
Tidal Vision Product, Inc.
3710 Iron Gate Rd
Bellingham, WA 98225

Optional Marketing Claims:

- Elicitor
- Elicitation of plant enzymes for plant vitality
- For Use Throughout the Growing Season
- Easy to Use
- Increases Yields
- Boost Your Production
- Enhance blooms and yields
- Promote Healthier Plants
- Healthier plants resist disease and pathogen attacks
- Improve plant vigor
- Fortifies plant defense mechanisms
- Elicit better crop performance
- Larger Flowers
- Robust Plant Growth Leads to Early Harvest
- Robust Plant Growth Leads to [Increase Yields][Larger Fruit][Larger Vegetables]
- Higher Pack-out equals more return per acre
- More large fruit
- Delays senescence
- Reduce bruising and blemishes
- Longer shelf life for crops
- Reduces ethylene production
- Elevate sugar content
- Overcomes environmental stress
- Healthier plants defend themselves better against nibblers
- Increases germination rates and seed vitality
- Improve sprouting
- Stronger emergence
- Increases biomass
- Better Stand Quality
- Induced Systemic Resistance against pathogens and disease
- Elevate defense mechanisms in plants
- Activate chemical engines within plants
- Boost Plant Health
- Amendment for better crop performance
- Healthier Stand
- Proprietary Elicitor
- Crop and Yield Promoter
- Broad spectrum Biopesticide
- Allows plants to defend for themselves against pathogen, disease and pests
- Fast acting formula
- Guaranteed not to be harmful to crops
- Chitosan is a biopolymer derived from crustacean shells, insect exoskeletons, and fungal cell walls.
- Boosts the ability of plants to defend against fungal infections
- [Product Name] provides protection against downy mildew, powdery mildew, early blight, late blight, gray mold, leaf spot, anthracnose, Stem wilt, damp-off, stem blight, stem cankering, and seed piece decay
- [Product Name] bolsters plant resistance against fungal diseases.
- Spray to plants throughout the growing season

- Mix and water plants throughout the growing season
- Indoor and outdoor use!
- [Product Name] provides long lasting systemic protection against disease, pathogens and pests
- More vigorous plants
- Results in healthier, more vigorous plants and increased yield
- [Product Name] enhances soil microflora and beneficial microbes
- [Product Name] shortens the time required for expression of mature plant resistance
- Fast results; mature plant resistance
- Stimulates growth
- Triggers the defensive mechanisms in plants for better production
- Use for bloom and fruit setting stimulation
- Protecting coating for fruits and vegetables
- Enhanced fruit protection
- [Product Name] triggers SIR in sunflower which increases antioxidant activity and vitamin C levels in plants
- Extends the shelf life of treated fruit and vegetables
- Increased resin-based defense capability
- Increased harvest yields
- Help trees protect against pine beetles and blue stem mold
- Love your trees – stop pine beetles
- Induced systemic resistance increases oleoresin flow and resinous lesion formulation
- Pre-arm trees while they have a fighting chance
- Proven effective to boost plant resistance
- Proven effective to elicit defense responses in pine trees
- Proven effective to elicit defense responses in pine trees against pine beetles and blue stain fungus
- Increases pine resin pitch-out to stop pine beetles
- Protects plants from harmful nematodes
- Protects plants and beneficial nematodes
- Stop the pine beetle
- Increases pine resin pitch-out when applied to the soil and/or needles, induces blue stain mold control for Integrated Pest Management (IPM) programs
- [Product Name] stimulates natural plant defense mechanisms in plants against environmental stress, pests, disease and drought
- Cost effective colloidal chitosan solution made from shellfish
- Inexpensive alternative to costly pesticides
- Generates healthy ROI for the grower
- Elicitor effect enhances plant defense mechanisms in combination with other seed treatmentsGenMax® provides a biostimulant effectfor your seed treatment program.
- Engineered for Performance
- Performance Engineered
- Tidal Grow® AgriScience
- GENMAX
- GENMAX OS

- GENMAX ST
- GENMAX IF
- Tidal Grow GENMAX OS
- Tidal Grow GENMAX

Crop Name	**Name of disease, pathogen, pest**
Apple	*Penicillium expansum*
Apple	*Botrytis cinerea* and *Penicillium expansum*
Barley	*Fusarium culmorum*
Carrot	*Sclerotinia sclerotiorum*
Celery	*Fusarium oxysporum*
Citrus	*Penicillium digitatum*
Conifers	*Ophiostoma minus*
Grand fir	Bark Beetle
Grapes	Gray mold
Grasses	Gray mold
Loblolly Pine	*Ophiostoma clavigerum*
Lodgepole Pine	*Ophiostoma minus*
Lodgepole Pine	*Ceratocystis clavigera*
Norway spruce	*Ceratocystis polonica* (the bark beetle-associated blue stain fungus)
Oranges Lemons	*Botrytis cinerea* and *Penicillium expansum*
Peach	*Botrytis cinerea*
Peanuts	*Penicillium*
Peas	*Nectria haematocca*
Peas	*Dendroctonus ponderosae* (Mountain pine beetle [MPB]) associated
Pine	Blue stain fungus
Pinus Nigra	*Sphaeropsis sapient* and *Diplodia scrobiculata*
Potato	*Penicillium*
Potato	*Verticillium*
Potato	*Rhizoctonia*
Potato	*Erwinia*
Potato	Nematode

Potato	Late Blight
Slash Pine	*Fusarium subglutinans, F. sp., Pini*
Soybeans	Cyst Nematode
Soybeans	White Mold
Strawberry	*Phytophthora cactorum*
Tomato	Cucumber mosaic virus
Tomato	*Fusarium oxysporum, F. sp.*
Tomato	*Cladosporium fulvum*
Tomato	Nematode
Western Pines	*Ophiostoma minus*
Wheat	*F. culmorum*

{Label version date 12/11/2024~~6/10/2024~~}

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Pesticide Programs
Biopesticides and Pollution Prevention Division (7511P)
1200 Pennsylvania Ave., N.W.
Washington, D.C. 20460

NOTICE OF PESTICIDE:
_X_ Registration
___ Reregistration
(under FIFRA, as amended)

EPA Reg. Number:	**Date of Issuance:**
95653-2	2/2/2021

Term of Issuance:
Unconditional

Name of Pesticide Product:
Chitocide

Name and Address of Registrant (include ZIP Code):

Concept Agri-Tek
1300 Plant Road
Charleston, MO 63834

Note: Changes in labeling differing in substance from that accepted in connection with this registration must be submitted to and accepted by the Biopesticides and Pollution Prevention Division prior to use of the label in commerce. In any correspondence on this product, always refer to the above EPA Registration Number.

On the basis of information furnished by the registrant, the above named pesticide is hereby registered under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA or the Act).

Registration is in no way to be construed as an endorsement or recommendation of this product by the U.S. Environmental Protection Agency (EPA). In order to protect health and the environment, the Administrator, on his or her motion, may at any time suspend or cancel the registration of a pesticide in accordance with the Act. The acceptance of any name in connection with the registration of a product under the Act is not to be construed as giving the registrant a right to exclusive use of the name or to its use if it has been covered by others.

This product is unconditionally registered in accordance with FIFRA section 3(c)(5) provided that you:

1. Submit and/or cite all data required for registration or registration review of your product when the EPA requires all registrants of similar products to submit such data.

2. Make the following labeling change before you release this product for shipment:

    - Revise the EPA Registration Number to read, "EPA Reg. No. 95653-2."

Signature of Approving Official:

Andrew C. Bryceland

\
Andrew Bryceland, Team Leader
Biochemical Pesticides Branch
Biopesticides and Pollution Prevention Division (7511P)
Office of Pesticide Programs

Date:

2/2/2021

EPA Form 8570-6

3. Submit one (1) copy of the final printed labeling for the record before you release this product for shipment.

Should you wish to add/retain a reference to your company's website on your label, then please be aware that the website becomes labeling under FIFRA and is subject to review by the EPA. If the website is false or misleading, the product will be considered to be misbranded and sale or distribution of the product is unlawful under FIFRA section 12(a)(1)(E). 40 CFR § 156.10(a)(5) lists examples of statements the EPA may consider false or misleading. In addition, regardless of whether a website is referenced on your product's label, claims made on the website may not substantially differ from those claims approved through the registration process. Therefore, should the EPA find or if it is brought to our attention that a website contains false or misleading statements or claims substantially differing from the EPA-approved registration, the website will be referred to the EPA's Office of Enforcement and Compliance Assurance.

Your release for shipment of this product constitutes acceptance of these terms. If these terms are not complied with, this registration will be subject to cancellation in accordance with FIFRA section 6. A stamped copy of the labeling is enclosed for your records. Please also note that the record for this product currently contains the following acceptable Confidential Statement of Formula (CSF)

- Basic CSF dated 02/02/2021

Any CSFs other than those listed above are superseded.

If you have any questions, please contact Alex Horansky of my team by phone at (703) 347-0128 or via email at Horansky.alex@epa.gov.

Sincerely,

Andrew Bryceland, Team Leader
Biochemical Pesticides Branch
Biopesticides and Pollution
Prevention Division (7511P)
Office of Pesticide Programs

Enclosure

[Brackets denote optional text [ ]]
{Braces denote notes to reviewer { }}
{front panel start}

ACCEPTED
02/02/2021
Under the Federal Insecticide, Fungicide and Rodenticide Act as amended, for the pesticide registered under
EPA Reg. No. 95653-2

MASTER LABEL

CHITOCIDE

{ALTERNATE NAME BRANDS:

BioAid-Nematicide

}

Biological Nematicide
For (effective) control/ suppression of plant-parasitic nematodes in the soil
For application to turf, fruit, vegetables, ornamentals, and row crops
Nematode Suppression/Control
[Label Reviewer Notes: Optional claims are also listed on last page]

For Commercial Use

Active Ingredients:

Quillaja Extract*…….……..	8.0%
Chitosan…….....	2.0%
Other Ingredients......	90.0%
Total	100.0%

*Product contains 0.69% Saponins of *Quillaja Saponaria*

KEEP OUT OF REACH OF CHILDREN

DANGER

{Note to Reviewer: In accordance with 40 CFR 156.68(d), all first aid statements, as prescribed, will appear on the front panel of the product label.}

FIRST AID	
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 treatment advice.
HOT LINE NUMBER Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-800-222-1222 for emergency medical treatment information	

See [Back] [Side] [Other] [Panel] for additional Precautionary Statements.

EPA Reg. No. 95653- **EPA Est. No. 95653-____**

Manufactured By:
Concept Agri-Tek, 1300 Plant Road, Charleston, MO 63834
Net Contents: ____ Gallons

{end front panel}

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

DANGER. Causes irreversible eye damage. Do not get in eyes or on clothing. Wear protective eyewear. 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. Note to Physician: Probable mucosal damage may contraindicate the use of gastric lavage.

ENVIRONMENTAL HAZARDS

For terrestrial uses: 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 washwater or rinsate.

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 interval. 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 48 hours.
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:

- Protective eyewear
- Long-sleeved shirt and long pants
- Shoes plus socks

GENERAL USE INSTRUCTIONS

Chitocide is a nematicide for use on agricultural crops against the pests listed in the Directions for Use section.

Apply Chitocide to the soil as a pre-plant, at planting or post-plant soil treatment on annual and perennial crops (refer to Directions for Use Table) alone, or applied through drip or border irrigation systems. Best results will be obtained from Pre-plant applications close to the actual planting times. The optimal application time must be determined based on the cultural practices and the nematode population dynamics. For perennial crops, apply Chitocide just prior to a root flush to protect young roots. Multiple applications may be required for crops with multiple root flushes. Chitocide must be applied to and incorporated into the soil. Incorporation may be accomplished by mechanical equipment, irrigation or rainfall. For soil applications made at planting, the action of some planters may provide sufficient incorporation. When using planters which do not provide adequate incorporation of Chitocide into the soil, equipment designed for incorporation may be used behind the planter.

Close scouting and early attention to infestations is highly recommended. Proper timing of application targeting newly hatched larvae, eggs or immature pests is important for optimal results.

Mixing Directions

Follow manufacturer's guidelines for cleaning spray equipment prior to mixing. Fill tank to desired amount with water, add all other spray components and agitate as directed. Buffer the mixture to pH to 5.0 or below before adding Chitocide. Start the mechanical or hydraulic agitation to provide moderate circulation before adding Chitocide. Add the desired volume of Chitocide to the mix tank and the remaining volume of water and continue circulation. Maintain circulation while loading and spraying. (Excessive agitation may lead to foaming of spray solution.) Do not mix more Chitocide than can be used in 24 hours.

Tank Mixing

Do not combine Chitocide in the spray tank with other pesticides, surfactants, adjuvants, or fertilizers if there has been no previous experience or use of the combination to show it is physically compatible, effective, or noninjurious under your use conditions.

To ensure compatibility of tank-mix combinations they must be evaluated prior to use. To determine the physical compatibility of this product with other products use a jar test. Using a quart jar, add the proportionate amounts of the products to one quart of water with agitation. Add dry formulations first, then flowables second, then emulsifiable concentrates last. After thoroughly mixing, let this mixture stand for 5 minutes. If the combination remains mixed or can readily be remixed, it is physically compatible. Once compatibility has been proven, use the same procedure for adding required ingredients to the spray tank.

Application Instructions

Chitocide can be applied to bare soil alone or with most types of pesticides and nutrients prior to planting, at planting, at transplant, in-season, pre- and post-harvest. Apply with a minimum of 10-30 gallons of water per acre to ensure complete coverage. Use a jar test to confirm physical compatibility prior to application.

Application to Field Soils Before Planting: Apply 1-2 pints of Chitocide per acre. Applications can be made by following methods:

- Drenching, drip (trickle) or sprinkler including center pivot, traveler, big gun, lateral move, end tow, side (wheel) roll, solid set, or hand move irrigation application.
- Surface spray on moist soil with 40-100 gallons water per acre.
- Surface spray with 20-40 gallons water per acre followed by overhead irrigation. Use enough irrigation water to wet the soil into the root zone.
- Direct injection to anticipated root depth using shank or other soil injection equipment. Apply with 30-40 gallons water per acre.

Pre-plant applications may be either broadcast over an entire field or concentrated (banded) into planting rows. Apply when soil temperature at 4-inch depth is 60ºF or higher. Bioactivity of Chitocide is greatest at soil temperatures between 70º and 90ºF. Apply to nematode-infested (non-fumigated) soil up to 14 days before planting or transplanting.

Application to field soils at planting: Apply 1-2 pints of Chitocide per acre. Applications can be made by following methods:

- Drenching, drip (trickle) or sprinkler including center pivot, traveler, big gun, lateral move, end tow, side (wheel) roll, solid set, or hand move irrigation application.
- Surface spray on moist soil with 40-100 gallons water per acre.
- Surface spray with 20-40 gallons water per acre followed by overhead irrigation. Use enough irrigation water to wet the soil into the root zone.

- Direct injection to anticipated root depth using shank or other soil injection equipment. Apply with 30-40 gallons water per acre.

Pre-plant applications may be either broadcast over an entire field or concentrated (banded) into planting rows. Apply when soil temperature at 4-inch depth is 60ºF or higher. Bioactivity of Chitocide is greatest at soil temperatures between 70º and 90ºF. Apply to nematode-infested (non-fumigated) soil up to 14 days before planting or transplanting.

Application to field soils at transplanting: Apply 1-2 pints of Chitocide per acre. Applications can be made by following methods:

- Drenching, drip (trickle) or sprinkler including center pivot, traveler, big gun, lateral move, end tow, side (wheel) roll, solid set, or hand move irrigation application.
- Surface spray on moist soil with 40-100 gallons water per acre.
- Surface spray with 20-40 gallons water per acre followed by overhead irrigation. Use enough irrigation water to wet the soil into the root zone.
- Direct injection to anticipated root depth using shank or other soil injection equipment. Apply with 30-40 gallons water per acre.

Pre-plant applications may be either broadcast over an entire field or concentrated (banded) into planting rows. Apply when soil temperature at 4-inch depth is 60ºF or higher. Bioactivity of Chitocide is greatest at soil temperatures between 70º and 90ºF. Apply to nematode-infested (non-fumigated) soil up to 14 days before planting or transplanting.

Application to field soils in season: Apply 1-2 pints of Chitocide per acre. Applications can be made by following methods:

- Drenching, drip (trickle) or sprinkler including center pivot, traveler, big gun, lateral move, end tow, side (wheel) roll, solid set, or hand move irrigation application.
- Surface spray on moist soil with 40-100 gallons water per acre.
- Surface spray with 20-40 gallons water per acre followed by overhead irrigation. Use enough irrigation water to wet the soil into the root zone.
- Direct injection to anticipated root depth using shank or other soil injection equipment. Apply with 30-40 gallons water per acre.

Pre-plant applications may be either broadcast over an entire field or concentrated (banded) into planting rows. Apply when soil temperature at 4-inch depth is 60ºF or higher. Bioactivity of Chitocide is greatest at soil temperatures between 70º and 90ºF. Apply to nematode-infested (non-fumigated) soil up to 14 days before planting or transplanting.

Application to field soils pre-harvest: Apply 1-2 pints of Chitocide per acre. Applications can be made by following methods:

- Drenching, drip (trickle) or sprinkler including center pivot, traveler, big gun, lateral move, end tow, side (wheel) roll, solid set, or hand move irrigation application.
- Surface spray on moist soil with 40-100 gallons water per acre.
- Surface spray with 20-40 gallons water per acre followed by overhead irrigation. Use enough irrigation water to wet the soil into the root zone.

- Direct injection to anticipated root depth using shank or other soil injection equipment. Apply with 30-40 gallons water per acre.

Pre-plant applications may be either broadcast over an entire field or concentrated (banded) into planting rows. Apply when soil temperature at 4-inch depth is 60ºF or higher. Bioactivity of Chitocide is greatest at soil temperatures between 70º and 90ºF. Apply to nematode-infested (non-fumigated) soil up to 14 days before planting or transplanting.

Application to field soils post-harvest: Apply 1-2 pints of Chitocide per acre. Applications can be made by following methods:

- Drenching, drip (trickle) or sprinkler including center pivot, traveler, big gun, lateral move, end tow, side (wheel) roll, solid set, or hand move irrigation application.
- Surface spray on moist soil with 40-100 gallons water per acre.
- Surface spray with 20-40 gallons water per acre followed by overhead irrigation. Use enough irrigation water to wet the soil into the root zone.
- Direct injection to anticipated root depth using shank or other soil injection equipment. Apply with 30-40 gallons water per acre.

Pre-plant applications may be either broadcast over an entire field or concentrated (banded) into planting rows. Apply when soil temperature at 4-inch depth is 60ºF or higher. Bioactivity of Chitocide is greatest at soil temperatures between 70º and 90ºF. Apply to nematode-infested (non-fumigated) soil up to 14 days before planting or transplanting.

FOR USE ON THE FOLLOWING CROPS FOR CONTROL/ SUPRESSION OF SPECIFIED NEMATODES
Pre-harvest Interval (PHI) = 0 day
Maximum Application Rate: 2 pints of BioAid – Nematicide per acre, per application. 10 pints of BioAid – Nematicide per acre, per year.

Crop Grouping	(including crops)	Pests	Application Rate
Cereal Grains[*]	Barley, Buckwheat, Corn (sweet and field), Millet, Oats, Rice, Sorghum, Milo and Wheat	Root-lesion nematode *Pratylenchus spp.* Root-knot nematode *Meloidogyne spp.* Reniform nematode *Rotylenchulus sp.* Sting nematode Belonolaimus *spp* Stem Nematode *Anguina spp*	Apply 1 pint to 2 pints of Chitocide per acre
Brassica (Cole) Leafy Vegetables[*]	Broccoli, Broccoli Raab, Brussels Sprouts, Cabbage, Chinese Broccoli, Chinese Cabbage (Bok Choy), Chinese Cabbage (Napa), Chinese Mustard Cabbage (Gai Choy), Cauliflower, Cavalo Broccolo, Collards, Kale, Kohlrabi, Mizuna, Mustard Greens, Mustard Spinach, and Rape Greens		
Bulb Vegetables[*]	Leek, Garlic, Onion (Bulb and Green) and Shallot		
Cotton[*]			

Cucurbit Vegetables[*]	Cucumber, Edible Gourds, Muskmelon, Cantaloupe, Pumpkin, Watermelon, and Winter and Summer Squash		
Fruiting Vegetables[*]	Tomato, Tomatillo, Pepper, Ground cherry, Pepino, Okra and Eggplant		
Grass Forage, Fodder and Hay[*]	Bermuda grass; bluegrass; and bromegrass or fescue		
Leafy Vegetables[*]	Arugula, Celery, Corn Salad, Cress, Dandelion, Dock, Edible Chrysanthemum, Endive, Fennel, Head Lettuce, Leaf Lettuce, Parsley, Purslane, Radicchio, Rhubarb, Spinach and Swiss Chard		
Legume Vegetables (Succulent or Dried) [*]	Bean (Lupinus) (includes grain lupin, sweet lupin, white lupin, and white sweet lupin); bean (Phaseolus) (includes field bean, kidney bean, lima bean, navy bean, pinto bean, runner bean, snap bean, tepary bean, wax bean); bean (Vigna) (includes adzuki bean, asparagus bean, blackeyed pea, catjang, Chinese longbean, cowpea, crowder pea, moth bean, mung bean, rice bean, southern pea, urd bean, yardlong bean); broad bean (fava); chickpea (garbanzo); guar; jackbean; lablab bean; lentil; pea (Pisum) (includes dwarf pea, edible-podded pea, English pea, field pea, garden pea, green pea, snowpea, sugar snap pea); pigeon pea; soybean; soybean (immature seed); sword bean		
Ornamentals[*]	Bare root, container bedding and landscape, shade and flowering trees, woody ornamentals		
Peanut[*]			

Root and Tuber Vegetables[*]	Artichoke, Black Salsify, Carrot, Cassava, Celeriac, Chayote Root, Chicory, Chinese Artichoke, Edible Burdock, Garden Beet, Ginger, Ginseng, Horseradish, Jerusalem Artichoke, Oriental Radish, Parsnip, Potatoes, Radish, Rutabaga, Salsify, Skirret, Spanish Salsify, Sugar Beet, Sweet Potatoes, Tumeric, Turnip, Turnip-rooted Chervil, Turnip-rooted, Parsley and Yams		
Strawberry[*]			
Tobacco[*]			
Turfgrass[*]	Ornamental lawns, golf courses, sod farms		

[not for use in California[*]]

CHEMIGATION

Posting of areas to be chemigated is required when 1) any part of a treated area is within 300 feet of sensitive areas such as residential areas, labor camps, businesses, day care centers, hospitals, in-patient clinics, nursing homes or any public areas such as schools, parks, playgrounds, or other public facilities not including public roads, or 2)when the chemigated area is open to the public such as golf courses or retail greenhouses.

Posting must conform to the following requirements. Treated areas shall be posted with signs at all usual points of entry and along likely routes of approach from the listed sensitive area. When there are no usual points of entry, signs must be posted in the corners of the treated areas and in any other locations affording maximum visibility to sensitive areas. The printed side of the sign should face away from the treated area towards the sensitive area. The signs shall be printed in English. Signs must be posted prior to application and must remain posted until foliage has dried and soil surface water has disappeared. Signs may remain in place indefinitely as long as they are composed of materials to event deterioration and maintain legibility for the duration of the posting period.

All words shall consist of letters at least 2 1/2 inches tall, and all letters and the symbol shall be a color which sharply contrasts with their immediate background. At the top of the sign shall be the words KEEP OUT, followed by an octagonal stop sign symbol at least 8 inches in diameter containing the word STOP. Below the symbol shall be the words PESTICIDES IN IRRIGATION WATER.

Application and Calibration Techniques for Sprinkler Irrigation

Apply this product only through the following types of irrigation systems: sprinkler including center pivot, traveler, big gun, lateral move, end tow, side (wheel) roll, solid set, or hand move irrigation; furrow; or drip (trickle) irrigation systems. Do not apply through any other types of irrigation systems. Crop injury, lack of effectiveness, or illegal pesticide residues in the crop can result from non-uniform distribution of treated water. If you have questions about calibration, you should contact State Experiment Station 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.
[*Not for use in California]

A. Center Pivot, Traveler, Big Gun, Lateral Move, End Tow, and Side (Wheel) Roll Irrigation Equipment: Operate system and injection equipment at normal pressures recommended by the manufacturer of injection equipment used. Fill tank of injection equipment with water. Operate system for one complete circle for center pivot or one complete run for the other recommended equipment, measuring time required, amount of water injected, and acreage contained in circle or run. Mix recommended amount of product for acreage to be covered into same amount of water used during calibration and inject into system continuously for one revolution or run,but continue to operate irrigation system until product has been cleared from last sprinkler head. Spray mixture in the chemical supply tank must be agitated at all times, otherwise settling and uneven application may occur.

B. Solid Set and Hand Move Irrigation Equipment: Determine acreage covered by sprinkler. Fill tank of injection equipment with water and adjust flow to use contents over a thirty to forty–five minute period. Mix desired amount of product for acreage to be covered into quantity of water used during calibration and operate entire system at normal pressures recommended by the manufacturer of injection equipment used for amount of time established during calibration. Provide constant mechanical agitation in the mix tank to insure that product will remain in suspension during the injection cycle. Product can be injected at the beginning or end or the irrigation cycle or as a separate application. Stop injection equipment after treatment is completed and continue to operate irrigation system until pesticide is cleared from last sprinkler head.

Safety Devices for Sprinkler Chemigation

1. The systems designated above 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 backflow.
2. All pesticide injection pipelines must contain a functional, automatic, quick-closing check valve to prevent the flow of fluid back toward the injection pump.
3. 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.
4. The system must contain functional interlocking controls to automatically shut off the pesticide injection pump when the water pump motor stops.
5. 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.
6. 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.
7. Do not apply when wind speed favors drift beyond the area intended for treatment.

Systems Connected to Public Water Sources

1. 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 a year.
2. Chemigation systems connected to public water systems must contain a functional, reduced-pressure zone backflow 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.
3. The pesticide injection pipeline must contain a functional, automatic, quick-closing check valve to prevent the flow of fluid back toward the injection pump.
4. 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.
5. 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.
6. 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.
7. Do not apply when wind speed favors drift beyond the area intended for treatment.

Furrow Chemigation[*]

1. Systems using a gravity flow pesticide dispensing system must meter the pesticide into the water at the head of the field and downstream of a hydraulic discontinuity such as a drop structure or weir box to decrease potential for water source contamination from backflow if water flow stops.
2. Systems utilizing a pressurized water and pesticide injection system must meet the following requirements:
    a. 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 backflow.
    b. The pesticide injection pipeline must contain a functional, automatic, quick closing check valve to prevent the flow of fluid back toward the injection pump.
    c. 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.
    d. The system must contain functional interlocking controls to automatically shut off the pesticide injection pump when the water pump motor stops.
    e. 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.
    f. 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.

Apply BioAid – Nematicide in sufficient water to penetrate into the root zone without excessive leaching into deeper soil.
[*Not for use in California]

Drip (Trickle) Chemigation[*]

1. 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 backflow.
2. The pesticide injection pipeline must contain a functional, automatic, quick-closing check valve to prevent the flow of fluid back toward the injection pump.
3. The pesticide injection pipeline must contain a functional, normally closed, solenoidoperated 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.
4. The system must contain functional interlocking controls to automatically shut off the pesticide injection pump when the water pump motor stops.
5. 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.
6. 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.

Apply BioAid – Nematicide in sufficient water to penetrate into the root zone without excessive leaching into deeper soil.
[*Not for use in California]

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal.
Pesticide Storage: Store in a cool dry place. Avoid freezing.
Pesticide Disposal: To avoid wastes, use all material in this container by application according to label directions. If wastes cannot be avoided, offer remaining product to a waste disposal facility or pesticide disposal program.
Container Handling:
[for containers equal to or less than 5 gallons]
Nonrefillable container. Do not reuse or refill this container. Triple rinse as follows: Empty the remaining contents into application equipment or mix tank and drain for 10 seconds after the flow begins to drip. Fill the container 1/4 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 if available, or puncture and dispose of in a sanitary landfill or by incineration. Do not burn unless allowed by state and local ordinances.

[for containers over 5 gallons]

Non-refillable container. Do not reuse or refill this container. Triple rinse container as follows: Empty the remaining contents into application equipment or a mix tank. Fill the container 1/4 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 more times. Then offer for recycling if available, or puncture and dispose of in a sanitary landfill or by incineration. Do not burn unless allowed by state and local ordinances.

DISCLAIMER OF WARRANTIES: CONCEPT AGRI-TEK makes no other warranties, express or implied, of merchantability or of fitness for a particular purpose or otherwise, that extend beyond the statements made on this label.

[May be printed directly on container] (Batch)(Lot) No._____

[Label Version 2/01/2021]

[Optional marketing claims]

- [Made] [Manufactured] in [the] U.S.A. [Flag Image]
- Biopesticide
- Bio-nematicide
- Bio-nematostat
- Protects against nematodes
- For Control/Suppression of Nematodes
- Chitocide is a novel nematicide formulation made from specialized ingredients
- Apply to Turf, Fruit, Vegetables, Ornamentals, and Row Crops
- Nematode Suppression/Control
- Low Usage Rate
- This product may be applied as often as and as many times as necessary (to maintain control) (of target pests)
- Chitocide Benefits (NOTE: as a header to list other claims)
- Effective Nematode suppression/control
- No special application equipment [required]
- [Chitocide] [Product] Can be applied with your standard spray regimen
- No special spray protocol required
- Not crop specific
- Apply at any time [in] [during] [the] growing season
- Apply anytime
- Spray any time in crop cycle
- Apply foliar or fertigation
- Packaged in 2.5 gallon jug, 275 gallon tote and bulk tanker
- For the protection of turfgrass (including sod farms) against damage caused by certain plant pathogenic nematodes.
- Broad spectrum control of nematodes
- Reduces populations of plant pathogenic nematodes
- Enhanced leaf color and turf density in the presence of plant pathogenic nematodes

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Pesticide Programs
Biopesticides and Pollution Prevention Division (7511P)
1200 Pennsylvania Ave., N.W.
Washington, D.C. 20460

NOTICE OF PESTICIDE:
_X_ Registration
___ Reregistration
(under FIFRA, as amended)

EPA Reg. Number:	**Date of Issuance:**
99270-1	3/7/2022

Term of Issuance:
Unconditional

Name of Pesticide Product:
KitoGreen®

Name and Address of Registrant (include ZIP Code):

KitoZyme S.A.
Rue de Milmort 680
Parc Industriel des Hauts-Sarts – Zone 2
Herstal, Belgium

Note: Changes in labeling differing in substance from that accepted in connection with this registration must be submitted to and accepted by the Biopesticides and Pollution Prevention Division prior to use of the label in commerce. In any correspondence on this product, always refer to the above EPA Registration Number.

On the basis of information furnished by the registrant, the above named pesticide is hereby registered under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA or the Act).

Registration is in no way to be construed as an endorsement or recommendation of this product by the U.S. Environmental Protection Agency (EPA). In order to protect health and the environment, the Administrator, on his or her motion, may at any time suspend or cancel the registration of a pesticide in accordance with the Act. The acceptance of any name in connection with the registration of a product under the Act is not to be construed as giving the registrant a right to exclusive use of the name or to its use if it has been covered by others.

This product is unconditionally registered in accordance with FIFRA section 3(c)(5) provided that you:

1. Submit and/or cite all data required for registration or registration review of your product when the EPA requires all registrants of similar products to submit such data.

2. Make the following labeling change before you release this product for shipment:

    - Revise the EPA Registration Number to read, “EPA Reg. No. 99270-1.”

Signature of Approving Official:

Andrew Bryceland, Team Leader
Biochemical Pesticides Branch
Biopesticides and Pollution Prevention Division (7511P)
Office of Pesticide Programs

Date:

3/7/2022

3. Submit one (1) copy of the final printed labeling for the record before you release this product for shipment.

Should you wish to add/retain a reference to your company's website on your label, then please be aware that the website becomes labeling under FIFRA and is subject to review by the EPA. If the website is false or misleading, the product will be considered to be misbranded and sale or distribution of the product is unlawful under FIFRA section 12(a)(1)(E). 40 CFR § 156.10(a)(5) lists examples of statements the EPA may consider false or misleading. In addition, regardless of whether a website is referenced on your product's label, claims made on the website may not substantially differ from those claims approved through the registration process. Therefore, should the EPA find or if it is brought to our attention that a website contains false or misleading statements or claims substantially differing from the EPA-approved registration, the website will be referred to the EPA's Office of Enforcement and Compliance Assurance.

Your release for shipment of this product constitutes acceptance of these terms. If these terms are not complied with, this registration will be subject to cancellation in accordance with FIFRA section 6. A stamped copy of the labeling is enclosed for your records. Please also note that the record for this product currently contains the following acceptable Confidential Statement of Formula (CSF):

- Basic CSF dated 12/22/2020

Any CSFs other than those listed above are superseded.

If you have any questions, please contact Gina Burnett of my team via email at burnett.gina@epa.gov

Sincerely,

Andrew Bryceland, Team Leader
Biochemical Pesticides Branch
Biopesticides and Pollution
Prevention Division (7511P)
Office of Pesticide Programs

Enclosure

KitoGreen®

ACTIVE INGREDIENT:
Chitosan……..…….85%
Other ingredients…….15%
Total.....100%

ACCEPTED
Mar 07, 2022
Under the Federal Insecticide, Fungicide and Rodenticide Act as amended, for the pesticide registered under
EPA Reg. No. 99270-1

KEEP OUT OF REACH OF CHILDREN

CAUTION

FIRST AID	
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 treatment advice.
If swallowed	● Call 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 by mouth 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 by mouth-to-mouth, if possible. ● Call a poison control center or doctor for further treatment advice.
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.
HOTLINE NUMBER Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-800-222-1222 for emergency medical treatment information.	

Manufactured by:
KitoZyme S.A.
Rue de Milmort 680
Parc Industriel des Hauts-Sarts – Zone 2
Herstal, Belgium
Tel: 0032 42 59 85 00
Email: info@kitozyme.com

EPA Reg. No._____ EPA Est. No._____

NET CONTENT : □ XX □ YY □ ZZ
Batch No:_____

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION: Causes moderate eye irritation. Avoid contact with eyes. Wear safety glasses or goggles. 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.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Applicators, mixers, loaders, pickers, and other handlers must wear:

- Hand protection: wear protective gloves
- Eye protection: chemical goggles or safety glasses
- Respiratory protection: wear appropriate mask
- Body protection: long sleeved shirt and long pants
- Feet protection: socks and shoes
- Other information: do not eat, drink or smoke during use

Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables, use detergent and hot water. Keep and wash PPE separately from other laundry.

USER SAFETY RECOMMENDATIONS

Users should:

- Remove clothing immediately if biopesticide gets inside. Then wash thoroughly and put on clean clothing.
- Remove PPE immediately after handling this product. Wash the outside of the gloves before removing. As soon as possible, wash thoroughly and change into clean clothing

ENVIRONMENTAL HAZARDS

For terrestrial uses: 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 washwater or rinsate.

PHYSICAL OR CHEMICAL HAZARDS

For spill, leak, fire, exposure, or accident call CHEMTREC at 1-800-424-9300.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

Formulators using this product are responsible for obtaining an EPA Registration for their formulated product. KitoGreen® may be used in agricultural end-use products for the purpose of bolstering plant defense.

For any requirements specific to your State or Tribe, consult the agency responsible for biopesticide 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

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. For any requirements specific to your State or Tribe, consult the agency responsible for biopesticide regulation.

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 biopesticides. 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. The requirements in this box only apply to uses of this product that are covered by the Worker Protection Standard.

The restricted-entry interval (REI) is 4 hours, do not allow worker entry into treated areas during the restricted-entry interval (REI).

PPE is 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
- Waterproof gloves
- Shoes plus socks

Exception: If the product is soil-injected or soil-incorporated, the Worker Protection Standard, under certain circumstances, allows workers to enter the treated area if there will be no contact with anything that has been treated.

NON-AGRICULTURAL USE REQUIREMENTS

The requirements in this box apply to uses of this product that are NOT within the scope of the Worker Protection Standard for agricultural biopesticides (40 CFR Part 170). The WPS applies when this product is used to produce agricultural plants on farms, forest, nurseries, and greenhouses.

Do not enter treated area without protective clothing until sprays have dried.

PRODUCT INFORMATION

KitoGreen® is a product containing 85% chitosan derived from fungal origin and other ingredients derived from the same fungal source. It is antibacterial, antifungal, and nematicide on listed agricultural crops. It prevents spore germination and causes existing mycelia to shrink and lose structural integrity. KitoGreen® is effective against nematodes, plant pathogens, soil and foliar

diseases including powdery and downy mildews, Botrytis, Sclerotinia spp., Phytophthora spp., leaf spot, early and late blight, anthracnose, stem wilt, damp-off, stem cankering and blast.
KitoGreen® will also stimulate the natural defense system of the plants, thanks to its eliciting effects, will increase seed germination, enhance seedling growth and vigor, and support healthier root systems.
KitoGreen® can be used throughout the growing season in greenhouse and field applications.

Integrated Pest Management: KitoGreen® can be used into an overall pest management strategy and following best management practices (or practices known to reduce disease development). It makes it less likely that disease will be established.

MIXING AND APPLICATION INSTRUCTIONS

Mixing: Partially fill the tank with clean water and begin the agitation. Acidify the water to a pH of 5 (for a final concentration of KitoGreen of 0.15% or less) or to a pH of 3.5 (for a final concentration of KitoGreen of 2% maximum). Add the desire quantity of KitoGreen® to the agitated water. Finish filling the tank to the desired volume to obtain the proper spray concentration. Use spray mixture immediately. Do not allow spray mixture to stand overnight or for prolonged periods.

Application: Apply KitoGreen® using conventional spray equipment or through sprinkler irrigation to the point of saturation. Good coverage and wetting is required. The amount of spray solution to apply will vary depending on the type of crop.

Compatibility: KitoGreen® may be tank mixed with some fungicides if pH can be maintained acidic. Consult specific product labels for additional information or restrictions concerning tank mixing. Observe the most restrictive of the labeling limitations and precautions of all products used in mixtures. It is always advisable to conduct a spray compatibility test when you plan to mix this product with another product. KitoGreen® has been evaluated for phytotoxicity on a variety of crops under various normal growing conditions. However, testing all crop varieties, in all mixtures and combinations is not feasible. Prior to treating entire crop, test a small portion of the crop for sensitivity.

FOLIAR APPLICATIONS

KitoGreen® can be applied as a foliar spray by ground and by air.

SOIL TREATMENT USE DIRECTIONS

KitoGreen® can be applied by soil drench, in-furrow spray, or soil injection to improve plant health and to protect against certain soil-borne diseases.
In general, KitoGreen® can be applied by the following methods:
Soil Drench Applications: Apply KitoGreen® at a concentration 0,13 lb - 0,90 lb/acre with sufficient water to thoroughly soak the growing media and root zone. Make an initial application during or shortly after transplant to control soil-borne diseases, reduce transplant shock, induce disease resistance, and to promote root growth. Multiple drench applications can be made every two weeks.
Injected Applications: KitoGreen® can be injected into the soil.

In-Furrow Applications: KitoGreen® can be applied at planting as an in-furrow spray. Direct the spray into the seed furrow just before the seeds are covered.

Application Rates for Selected Crops

Crops	Target Disease	Application Method	Dose (min-max) per acre	Notes
Artichoke	Powdery Mildew (*Erysiphe cichoracearum*) (*Leveillula taurica*) Ramularia Leaf Spot (*Ramularia cynarae)* Gray Mold *(Botrytis cinerea)* White Mold *(Sclerotinia sclerotiorum)*	Foliar (Ground or Aerial)	0,13 lb - 0,90 lb	Apply this product preventatively or at the first sign of disease symptoms are visible. Reapply every 7 – 14 days. Use min 0,13 lb/acre for preventive effects and max 0,90 lb/acre for curative effects.
Asparagus	Botrytis Blight (*Botrytis cinerea*) Rust (Puccinia aspargi)	Foliar (Ground or Aerial)	0,13 lb - 0,90 lb	Apply this product preventatively or at the first sign of disease symptoms are visible. Reapply every 7 – 14 days. Use min 0,13 lb/acre for preventive effects and max 0,90 lb/acre for curative effects.
Berries, including: Blackberry, Blueberry, Bushberry, Caneberry, Cranberry, Currants, Elderberry, Gooseberry, Huckleberry, Loganberry and Raspberry.	Botrytis Blight (*Botrytis cinerea*) Mummy Berry (*Monilinia vaccinii-corymbosi*) Alternaria Fruit Rot (*Alternaria spp.*) Anthracnose Fruit Rot (Colletotrichum acutatum) Bacterial Canker (*Pseudomonas syringae*) Leaf Rust (*Pucciniastrum vaccinii*) Leaf Spot and Blotch	Foliar (Ground or Aerial) Soil	0,13 lb - 0,90 lb	Apply this product preventatively or at the first sign of disease symptoms are visible. Reapply every 7 – 14 days. Use min 0,13 lb/acre for preventive effects and max 0,90 lb/acre for curative effects.

Crops	Target Disease	Application Method	Dose (min-max) per acre	Notes
	(*Mycosphaerella spp.*) (*Septoria* spp.) Phomopsis Leaf Spot, Twig Blight and Fruit Rot (*Phomopsis* spp.) Powdery Mildew (*Microsphaera alni*) Spur Blight (*Didymella* spp.) *Phoma* spp. Nematodes (*Nematoda*)			
Bulb Vegetables, including: Garlic, Leeks, Onions (Bulb and Green), Shallots, And other bulb vegetable crops	Botrytis Leaf Blight (*Botrytis squamosa*) Botrytis Neck Rot (*Botrytis* spp.) Onion Purple Blotch (*Alternaria* porri) Downy Mildew (*Peronospora* spp.) Powdery Mildew (*Erysiphe* spp.) Rust (*Puccinia porri*) Stemphyllium Leaf Blight (*Stemphylium vesicarium*) *Fusarium* spp. *Pythium* spp. *Rhizoctonia* spp. Nematodes (*Nematoda*)	All applications	0,13 lb - 0,90 lb	Apply this product preventatively or at the first sign of disease symptoms are visible. Reapply every 7 – 14 days. Use min 0,13 lb/acre for preventive effects and max 0,90 lb/acre for curative effects.

Crops	Target Disease	Application Method	Dose (min-max) per acre	Notes
Cereal Grains, including: Barley, Buckwheat, Grain Amaranth, Milo, Oat, Millets, Rice, Rye, Sorghum, Triticale and Wheat	Powdery Mildew (*Erysiphe graminis*) Bacterial Blight and Streak (*Xanthomonas* spp.) Brown Rot, Leaf Spots & Smuts (*Ceratobasidium* spp.) (*Cercospora* spp.) (*Drechslera* spp.) Rice Blast (*Pyricularia grisea*) Rust (*Puccinia* spp.) Septoria Leaf Spot (*Septoria* spp.) Sheath Spot and Blight (*Rhizoctonia oryzae*) (*Thanatephorus cucumeris*) Stem Rot (*Sclerotium oryzae*) Smut (*Tilletia barclayana*)	Foliar (Ground and Arial)	0,13 lb - 0,90 lb	Apply this product preventatively or at the first sign of disease symptoms are visible. Reapply every 7 – 14 days. Use min 0,13 lb/acre for preventive effects and max 0,90 lb/acre for curative effects.
Citrus Fruits, including: Calamondin, Citrus citron, Citrus hybrids, Grapefruit, Kumquat, Lemon, Lime, Mandarin, Orange (sour and sweet), Pummelo and Satsuma mandarin	Bacterial Canker (*Xanthomonas* spp.) Alternaria Brown Spot (*Alternaria alternata*) Bacterial Blast (*Pseudomonas syringae*) Black Spot (*Guignardia citricarpa*) (*Phyllosticta*	Foliar (Ground and Arial)	0,13 lb - 0,90 lb	Apply this product preventatively or at the first sign of disease symptoms are visible. Reapply every 7 – 14 days. Use min 0,13 lb/acre for preventive effects and max 0,90 lb/acre for curative effects.

Crops	Target Disease	Application Method	Dose (min-max) per acre	Notes
	citricarpa) Greasy Spot (*Mycosphaerella citri*) Melanose (*Diaporthe citri*) Postbloom Fruit Drop (*Colletotrichum acutatum*) Scab (*Elsinoe australis*) (*Elsinoe fawcetti*)			
Cole Crops - (Brassicas), including: Broccoli, Broccoli Rabe, Brussels Sprouts, Cabbage, Chinese Broccoli, Chinese Cabbage (Bok Choy), Chinese Cabbage (Napa), Chinese Mustard Cabbage (Gai Choy), Cauliflower, Cavalo, Collards, Kale, Kohlrabi, Mizuna Mustard Greens, Mustard Spinach, Rape Greens, Turnip	Powdery Mildew (*Erysiphe cruciferarum*) (*Erysiphe polygoni*) Alternaria Leaf Spot (*Alternaria spp.*) Downy Mildew (*Peronospora parasitica*) Pin Rot Complex (*Alternaria, Xanthomonas*) Xanthomonas Leaf Spot (*Xanthomonas campestris*) White Rust (*Albugo candida*) Nematodes (*Nematoda*)	Foliar (Ground and Arial) Soil	0,13 lb - 0,90 lb	Apply this product preventatively or at the first sign of disease symptoms are visible. Reapply every 7 – 14 days. Use min 0,13 lb/acre for preventive effects and max 0,90 lb/acre for curative effects.
Corn, including: Sweet Corn, Field Corn, Popcorn, Silage Corn and Seed Corn	Anthracnose Leaf Blight (*Colletotrichum graminicola*) Eye Spot (*Aureobasidium zeae*) Gray Leafspot (*Cercospora zeae- maydis*) Rusts (*Puccinia*	Foliar (Ground and Arial)	0,13 lb - 0,90 lb	Apply this product preventatively or at the first sign of disease symptoms are visible. Reapply every 7 – 14 days. Use min 0,13 lb/acre for preventive effects and max 0,90 lb/acre for curative effects.

Crops	Target Disease	Application Method	Dose (min-max) per acre	Notes
	spp.) Northern Leaf Blight (*Cochiliobus carbonum*) Southern Leaf Blight (*Cochiliobus heterostrophus*)			
Cotton	Alternaria Leaf Spot, Boll Rot (*Alternaria* spp.) Anthracnose, Boll Rot (*Anthracnose* spp.) Ascochyta Blight, Boll Rot (*Ascochyta* spp.) Cercospora Blight and Leaf Spot (*Cercospora* spp.) Diplodia Boll Rot (*Diplodia* spp.) Hard Lock, Boll Rot *(Fusarium* spp.) Leaf Spot (*Corynespora cassicola*) Phoma Blight, Boll Rot *(Phoma* spp.) Rust *(Puccinia* spp.) (*Phykopsora* spp.) Stemphyllium Leaf Spot (*Stemphyllium* spp.) Nematodes (*Nematoda*)	Foliar (Ground and Arial) Soil	0,13 lb - 0,90 lb	Apply this product preventatively or at the first sign of disease symptoms are visible. Reapply every 7 – 14 days. Use min 0,13 lb/acre for preventive effects and max 0,90 lb/acre for curative effects.

Crops	Target Disease	Application Method	Dose (min-max) per acre	Notes
Cucurbits Includes all types and hybrids of: Chayote, Chinese Waxgourd, Cucumber, Citron Melon, Gherkin, Pumpkin and Watermelon **Edible Gourd:** Chinese Okra, Cucuzza and Hyotan ***Mormordica* spp.:** Balsam Apple, Balsam Pear, Bitter Melon and Chinese Cucumber **Muskmelon:** Cantaloupe, Casaba, Crenshaw Melon, Golden Pershaw Melon, Honeydew Melon, Honey Balls, Mango Melon, Persian Melon, Pineapple Melon, Santa Clause Melon and Snake Melon **Summer Squash:** Crookneck Squash, Scallop Squash, Straightneck Squash, Vegetable Marrow and Zucchini **Winter Squash:** Acorn Squash, Butternut Squash, Calabaza, Gubbard Squash and Spaghetti Squash	Powdery Mildew (*Erysiphe cichoracearum*) (*Sphaerotheca fuliginea*) Anthracnose (*Colletotrichum lagenarium*) Alternaria Leaf Spot (*Cercospora citrulina*) Downy Mildew (*Pseudoperonospora cubensis*) Gummy Stem Blight (*Didymella bryoniae*) Phytophthora Blight (*Phytophthora capsici*) *Fusarium* spp. *Phytophthora* spp. *Pythium* spp. *Rhizoctonia* spp. Nematodes (*Nematoda*)	All applications	0,13 lb - 0,90 lb	Apply this product preventatively or at the first sign of disease symptoms are visible. Reapply every 7 – 14 days. Use min 0,13 lb/acre for preventive effects and max 0,90 lb/acre for curative effects.

Crops	Target Disease	Application Method	Dose (min-max) per acre	Notes
And other cucurbit crops				
Fruiting Vegetables, including: Eggplant, Okra, Pepper, Tomato, Tomatillo and Ground Cherry	Bacterial Blight (*Xanthomonas* spp.) Bacterial Spot (*Xanthomonas* spp.) Bacterial Speck (*Pseudomonas syringae*) Black Mold (*Alternaria alternata*) Early Blight (*Alternaria solani*) Gray Mold (*Botrytis cinerea*) Late Blight (*Phytophthora capsici*) Powdery Mildew (*Erysiphe* spp.) (*Leveillula taurica*) (*Oidopsis taurica*) (*Sphaerotheca* spp.) Target Spot (*Corynespora cassiicola*) *Fusarium* spp. *Phytopthora* spp. *Rhizoctonia* spp. *Verticllium* spp. Nematodes (*Nematoda*)	All applications	0,13 lb - 0,90 lb	Apply this product preventatively or at the first sign of disease symptoms are visible. Reapply every 7 – 14 days. Use min 0,13 lb/acre for preventive effects and max 0,90 lb/acre for curative effects.
Grapes	Powdery Mildew (*Uncinula necator*) Angular Leaf Spot (*Mycosphaerella angulata*) Anthracnose (*Elsinoe*	All applications	0,13 lb - 0,90 lb	Apply this product preventatively or at the first sign of disease symptoms are visible. Reapply every 7 – 14 days. Use min 0,13 lb/acre for preventive effects and

Crops	Target Disease	Application Method	Dose (min-max) per acre	Notes
	ampelina) Botrytis Bunch Rot (*Botrytis cinerea)* Black Rot (*Guignardia bidwellii*) Downy Mildew (*Plasmopara viticola*) Eutypa (*Eutypa lata*) Leaf Blight (*Pseudocercospora vitis*) Phomopsis Fruit Rot (*Phomopsis viticola*) Ripe Rot (*Colletotrichum gloeosporioides*) Sour Rot (*Alternaria tenuis*) (*Aspergillus* spp.) (*Botrytis cinerea*) (*Cladosporium herbarum*) (*Penicillium* spp.) (*Rhizopus arrhizus*) Nematodes (*Nematoda*)			max 0,90 lb/acre for curative effects.
Grass Seed	Powdery Mildew (*Erysiphe gramminis*) (*Oidium* spp.) (*Podosphaera* spp.) (*Sphaerotheca* spp.) Rust (*Puccinia* spp.)	Foliar (Ground)	0,13 lb - 0,90 lb	Apply this product preventatively or at the first sign of disease symptoms are visible. Reapply every 7 – 14 days. Use min 0,13 lb/acre for preventive effects and max 0,90 lb/acre for curative effects.
Hops	Downy Mildew (*Pseudoperonospora humili*) Powdery Mildew	Foliar (Ground)	0,13 lb - 0,90 lb	Apply this product preventatively or at the first sign of disease symptoms are visible.

Crops	Target Disease	Application Method	Dose (min-max) per acre	Notes
	(*Sphaerotheca macularis*)			Reapply every 7 – 14 days. Use min 0,13 lb/acre for preventive effects and max 0,90 lb/acre for curative effects.
Leafy Vegetables, including: Arugula, Beet, Celery, Chervil, Cilantro, Corn Salad, Cress, Dandelion, Dock, Edible Chrysanthemum, Endive, Fennel, Garden Peas, Head Lettuce, Leaf Lettuce, Parsley, Purslane, Radicchio, Rhubarb, Spinach, Swiss Chard and Watercress	Downy Mildew (*Bremia lactuca*) (*Peronospora* spp.) Bacterial Blight/Rot (*Xanthomonas* spp.) Cercospora Leafspot (*Cercospora* spp.) Late Blight (*Septoria apiicola*) Pink Rot (*Sclerotinia sclerotiorum*) Powdery Mildew (*Erysiphe cichoracearum*) Sclerotinia Had and Leaf Drop (*Sclerotinia minor*) (*Sclerotinia sclerotiorum*) White Rust (*Albugo occidentalis*) Nematodes (*Nematoda*)	Foliar (Ground), In-Furrow and Soil	0,13 lb - 0,90 lb	Apply this product preventatively or at the first sign of disease symptoms are visible. Reapply every 7 – 14 days. Use min 0,13 lb/acre for preventive effects and max 0,90 lb/acre for curative effects.
Legumes, succulent and dried, (not including soybeans and peanuts)**:** Chick Peas, Dry Beans, Garbanzo Beans, Green	Bacterial Blight (*Xanthomonas campestris*) Gray Mold (*Botrytis cinerea*) Pythium (aerial blight phase) (*Pythium* spp.)	Foliar (Ground), In-Furrow and Soil	0,13 lb - 0,90 lb	Apply this product preventatively or at the first sign of disease symptoms are visible. Reapply every 7 – 14 days. Use min 0,13 lb/acre for preventive effects and

Crops	Target Disease	Application Method	Dose (min-max) per acre	Notes
Beans, Lentils, Lima Beans, Peas, Shell Beans, Snap Beans, Split Peas, And other legume crops	Powdery Mildew (*Erysiphe* spp.) Rust (*Puccinia* spp.) (*Uromyces appendiculatus*) White Mold (*Sclerotinia sclerotiorum*) *Fusarium* spp. *Phytophthora* spp. *Rhizoctonia* spp. Nematodes (*Nematoda*)			max 0,90 lb/acre for curative effects.
Mint and other Herbs/Spices, including: Angelica, Balm, Basil, Borage, Burnet, Chamomile, Catnip, Chervil, Chive, Clary, Coriander, Costmary, Cilantro, Curry, Dillweed, Horehound, Hyssop, Lavender, Lemongrass, Lovage, Marjoram, Nasturtium ,Parsley (dried), Peppermint, Rosemary, Sage, Savory (summer and winter), Sweet Bay, Tansy, Tarragon, Thyme, Wintergreen, Woodruff and Wormwood	Downy Mildew (*Peronospora* spp.) Powdery Mildew (*Erysiphe* spp.) Rust (*Puccinia menthae*) Nematodes (*Nematoda*)	Foliar (Ground and Arial) Soil	0,13 lb - 0,90 lb	Apply this product preventatively or at the first sign of disease symptoms are visible. Reapply every 7 – 14 days. Use min 0,13 lb/acre for preventive effects and max 0,90 lb/acre for curative effects.
Oil Seed Crops, including (not including cotton, peanut or soybean)**:**	Bacterial Pustule (*Xanthomonas* spp.) Bacterial Speck (*Pseudomonas*	Foliar (Ground and Arial) Soil	0,13 lb - 0,90 lb	Apply this product preventatively or at the first sign of disease symptoms are visible. Reapply every 7 – 14

Crops	Target Disease	Application Method	Dose (min-max) per acre	Notes
Canola, Castor, Flax, Rapeseed, Safflower, Sesame and Sunflower	*syringe pv. glycinea*) Brown Spot (*Septoria glycines*) Cercospora Leaf Spot *(Cercospora* spp.) Downy Mildew *(Peronospora mansherica*) Pod and Stem Blight (*Diaporthe phaseolorum* var. sojae) (*Phomopsis longicola*) White Mold/Sclerotinia Stem Rot (*Sclerotinia sclerotiorum*) Nematodes (*Nematoda*)			days. Use min 0,13 lb/acre for preventive effects and max 0,90 lb/acre for curative effects.
Olive	Olive Knot (*Pseudomonas savastanoi*)	Foliar (Ground and Arial)	0,13 lb - 0,90 lb	Apply this product preventatively or at the first sign of disease symptoms are visible. Reapply every 7 – 14 days. Use min 0,13 lb/acre for preventive effects and max 0,90lb/acre for curative effects.
Ornamental Plants: **Herbaceous Ornamentals:** Flowering Plants and Foliage Plants **Woody Ornamentals:** Broadleaves, Shrubs and trees Conifers, Shrubs and trees	Anthracnose (*Colletotrichum* spp.) Bacteria *(Erwinia* spp.) (Pseudomonas spp.) *(Xanthomonas* spp.) Black Spot of Rose (*Diplocarpon*	All applications	0,13 lb - 0,90 lb	Apply this product preventatively or at the first sign of disease symptoms are visible. Reapply every 7 – 14 days. Use min 0,13 lb/acre for preventive effects and max 0,90lb/acre for curative effects.

Crops	Target Disease	Application Method	Dose (min-max) per acre	Notes
	rosae) Blossom Blight *(Monilinia* spp.) Downy Mildew (*Peronospora* spp.) (*Plasmopara viburni*) Gray Mold (*Botrytis cinerea*) Leaf Spot (*Alternaria* spp.) (*Cercospora* spp.) (*Entomosporium* spp.) (*Myrothecium* spp.) (*Septoria* spp.) Powdery Mildew (*Erysiphe* spp.) (*Oidium* spp.) (*Podosphaera* spp.) (*Sphaerotheca* spp.) Rust (*Puccinia* spp.) (*Albugo candida*) Scab (*Venturia* spp.) Alternaria leaf spot (*Alternaria alternata*) *Calonectria* spp. *Cladosporium* spp. *Fusarium* spp. *Phytophthora* spp. *Pythium* spp. *Rhizoctonia* spp. *Verticillium* spp. Nematodes (*Nematoda*)			

Crops	Target Disease	Application Method	Dose (min-max) per acre	Notes
Peanut	Aspergillus Crown Rot (*Aspergillus niger*) Rhizoctonia Foliar Blight, Peg, and Root Rot (*Rhizoctonia solani*) White Mold (*Sclerotium rolfsii*) Aspergillus Crown Rot (*Aspergillus niger*) *Fusarium* spp. *Phytophthora* spp. *Pythium* spp. *Rhizoctonia* spp. *Verticillium* spp. White Mold (*Sclerotium rolfsii*) Nematodes (*Nematoda*)	All Applications	0,13 lb - 0,90 lb	Apply this product preventatively or at the first sign of disease symptoms are visible. Reapply every 7 – 14 days. Use min 0,13 lb/acre for preventive effects and max 0,90 lb/acre for curative effects.
Pome Fruits, including: Apple, Crabapple, Loquat, Mayhaw Pear, Pear oriental and Quince	Powdery Mildew (*Podosphaera leucotricha*) Alternaria Blotch (*Alternaria mali*) Apple Scab (*Venturia inaequalis)* Bitter Rot (*Colletotrichum* spp.) Black Rot/ Frogeye Leaf Spot (*Botryosphaeria obtusa*) Bot Rot (*Botryosphaeria*	Foliar	0,13 lb - 0,90 lb	Apply this product preventatively or at the first sign of disease symptoms are visible. Reapply every 7 – 14 days. Use min 0,13 lb/acre for preventive effects and max 0,90 lb/acre for curative effects.

Crops	Target Disease	Application Method	Dose (min-max) per acre	Notes
	dothidea) Brooks Spot (*Mycosphaerella pomi*) Bull's Eye Rot (*Neofabraea* spp.) Cedar-Apple Rust (*Gymnosporangium juniper-virginiana e*) Fire Blight (*Erwinia amylovora*) Flyspeck (*Zygophiala jamaicensis*) Sooty Blotch (*Geastrumia polystigmati*) (*Leptodontium elatius*) (*Peltaster fructicola*) White Rot (*Botryosphaeria dothidea*)			
Root, Tuber and Corm Vegetables, including: Beets, Carrots, Cassava, Ginger, Ginseng, Horseradish, Potato, Radish, Sugar beets, Sweet potato, Yams and Turnip	Bacterial Leaf Blight (*Xanthomonas campestris*) Black Root Rot / Black Crown Rot (*Alternaria* spp.) Downy Mildew (*Peronospora* spp.) Early Blight (*Alternaria* spp.) Gray Mold (*Botrytis cinerea*) Late Blight (*Phytophthora infestans*) Powdery Mildew (*Erysiphe* spp.)	All Applications	0,13 lb - 0,90 lb	Apply this product preventatively or at the first sign of disease symptoms are visible. Reapply every 7 – 14 days. Use min 0,13 lb/acre for preventive effects and max 0,90 lb/acre for curative effects.

Crops	Target Disease	Application Method	Dose (min-max) per acre	Notes
	White Mold (*Sclerotinia sclerotiorum*) Clubroot (*Plasmodiophora brassicae*) Common Scab (*Streptomyces scabies*) *Fusarium* spp. *Phytopthora* spp. *Pythium* spp. *Rhizoctonia* spp. *Verticillium* spp. Nematodes (*Nematoda*)			
Soybean	Aerial Web Blight (*Rhizoctonia solani*) Alternaria Leafspot (*Alternaria* spp.) Anthracnose (*Colletotrichum truncatum*) Asian Soybean Rust (*Phakopsora pachyrhizi*) Brown Spot (*Septoria glycines*) Cercospora Blight (*Cercospora kikuchii*) Frog-eyed Leaf spot (*Cercospora sojina*) Pod and Stem Blight (*Diaporthe* spp.) Septoria Brown Spot (*Septoria glycines*) White Mold (*Sclerotinia*	All Applications	0,13 lb - 0,90 lb	Apply this product preventatively or at the first sign of disease symptoms are visible. Reapply every 7 – 14 days. Use min 0,13 lb/acre for preventive effects and max 0,90 lb/acre for curative effects.

Crops	Target Disease	Application Method	Dose (min-max) per acre	Notes
	sclerotiorum) *Fusarium* spp. *Phytopthora* spp. *Pythium* spp. *Rhizoctonia* spp Nematodes (*Nematoda*)			
Stone Fruits, including: Apricot, Cherry (sweet and tart), Nectarine, Peach, Plum, Plumcot and Prune (fresh)	Alternaria Spot/Fruit Rot (*Alternaria alternata*) Anthracnose (*Colletotrichum* spp.) Bacterial Canker (*Pseudomonas* spp.) Bacterial Spot (*Pseudomonas* spp.) Brown Rot Blossom Blight and Fruit Rot (*Monilinia* spp.) Cercospora Leaf Spot (*Cercospora* spp.) Cherry Leaf Rot (*Blumeriella jaapii*) Gray Mold (*Botrytis cinerea*) Jacket Rot, Green Fruit Rot (*Botrytis cinerea*, *Monilinia* spp., *Sclerotinia sclerotiorum*) Powdery Mildew (*Podosphaera* spp.) (*Sphaerotheca pannosa*) Rust (*Tranzschelia discolor*)	All Applications	0,13 lb - 0,90 lb	Apply this product preventatively or at the first sign of disease symptoms are visible. Reapply every 7 – 14 days. Use min 0,13 lb/acre for preventive effects and max 0,90 lb/acre for curative effects.

Crops	Target Disease	Application Method	Dose (min-max) per acre	Notes
	Rusty Spot (*Podosphaera leucotricha*) Scab (*Cladosporium carpophilium*) Shot Hole (*Wilsonomyces carpophilus*)			
Strawberry	Anthracnose (*Colletotrichum* spp.) Botrytis (*Botrytis cinerea*) Leaf Spot (*Mycosphaerella fragariae*) Phomopsis Leaf Blight (*Phomopsis obscurans*) Powdery Mildew (*Sphaerotheca macularis*) Black Root Rot (*Rhizoctonia* spp.) (*Pythium* spp.) (*Fusarium* spp.) (*Cylindrocarpon* spp.) Phytophthora Root Rot and Crown Rot (*Phytophthora* spp.) Verticillium Wilt (*Verticillium* spp.) *Pythium* spp. Nematodes (*Nematoda*)	All Applications	0,13 lb - 0,90 lb	Apply this product preventatively or at the first sign of disease symptoms are visible. Reapply every 7 – 14 days. Use min 0,13 lb/acre for preventive effects and max 0,90 lb/acre for curative effects.

Crops	Target Disease	Application Method	Dose (min-max) per acre	Notes
Sugar Beets	Powdery Mildew (*Erysiphe betae*) (*Erysiphe polygoni*) Leaf Spot (*Cercospora beticola*) Ramularia (*Ramularia* spp.) Rust (*Uromyces betae*) Nematodes (*Nematoda*)	Foliar Soil	0,13 lb - 0,90 lb	Apply this product preventatively or at the first sign of disease symptoms are visible. Reapply every 7 – 14 days. Use min 0,13 lb/acre for preventive effects and max 0,90 lb/acre for curative effects.
Sugarcane	Brown Rust (*Puccinia melanocephela*) Orange Rust (*Puccinia kuehnii*) Nematodes (*Nematoda*)	Foliar (Ground) and Aerial) Soil	0,13 lb - 0,90 lb	Apply this product preventatively or at the first sign of disease symptoms are visible. Reapply every 7 – 14 days. Use min 0,13 lb/acre for preventive effects and max 0,90 lb/acre for curative effects.
Tobacco	Blue Mold (*Peronospora tabacina*) *Fusarium* spp. *Phytophthora* spp. *Pythium* spp. *Rhizoctonia* spp. *Verticillium* spp.	Foliar and Plant Drench	0,13 lb - 0,90 lb	Apply this product preventatively or at the first sign of disease symptoms are visible. Reapply every 7 – 14 days. Use min 0,13 lb/acre for preventive effects and max 0,90 lb/acre for curative effects.
Tree nuts, including: Almond, Beech nut, Brazil nut, Butternut, Cashew, Chestnut, Chinquapin, Filbert (hazelnut), Hickory nut, Macadamia nut, Pecan and Walnut (Black and English)	Walnut Blight (*Xanthomonas campestris*) Alternaria Late Blight, Alternaria Leaf Spot (*Alternaria spp.*) Anthracnose (*Colletotrichum* spp.) (*Gnomonia leptostyla*) Bacterial Canker	Foliar (Ground) and Aerial)	0,13 lb - 0,90 lb	Apply this product preventatively or at the first sign of disease symptoms are visible. Reapply every 7 – 14 days. Use min 0,13 lb/acre for preventive effects and max 0,90 lb/acre for curative effects.

Crops	Target Disease	Application Method	Dose (min-max) per acre	Notes
	(*Erwinia nigrifluens*) Botryosphaeria Blight (*Botryosphaeria dothidea*) Brown Rot (*Monilinia* spp.) Jacket Rot, Green Fruit Rot *(Botrytis cinerea, Monilinia* spp*., Sclerotinia sclerotiorum)* Eastern Filbert Blight (*Anisogramma anomala*) Leaf Rust (*Tranzschelia discolor*) Scab (*Cladosporium carpophilium*) (*Sphaceloma perseae*) Shot Hole (*Wilsonomyces carpophilus*)			
Tropical Fruits, including: Avocado, Banana, Kiwi, Mango, Papaya, Plantain, Pineapple and Pomegranate	Anthracnose (*Colletotrichum gloeosporioides*) Bacterial Blight (*Pseudomonas syringae*) (*Pseudomonas viridiflava*) Bacterial Canker (*Xanthomonas campestris*) Botrytis Fruit Rot (*Botrytis cinerea*) Scab (*Elsinoe mangiferae*) Sigatoka (*Mycosphaerella*	Foliar (Ground) Soil	0,13 lb - 0,90 lb	Apply this product preventatively or at the first sign of disease symptoms are visible. Reapply every 7 – 14 days. Use min 0,13 lb/acre for preventive effects and max 0,90 lb/acre for curative effects.

Crops	Target Disease	Application Method	Dose (min-max) per acre	Notes
	fijiensis) Nematodes (*Nematoda*)			
Grass (Sport fields, Golf courses), including: Bent grass, Bermuda grass, Bluegrass, Centipede grass, Dichondra, Fescue, Rye grass, Wheat grass, Zoysia grass, St. Augustine.	Brown patch and Large patch (*Rhizoctonia solani*) Pythium blight and Pythium Root Rot (*Pythium* spp.) Pink snow mold and Fusarium Patch (*Microdochium nivale*) Summer patch (*Magnaporthe poae*) Necrotic Ring Spot (*Ophiosphaerella korrae*) Bentgrass Dead Spot (*Ophiosphaerella agrostis*) Spring Dead Spot (*Ophiosphaerella* spp.) Take-all Patch (*Gaeumannomyces graminis* var. *avenae*) Superficial Fairy Ring (*Coprinus kubickae, Melanotus phillipsii, Trechispora* spp.) Yellow Tuft (Downy Mildew) (*Sclerophthora macrospora)* Powdery Mildew (*Erysiphe*	Foliar (Ground) and Aerial)	0,13 lb - 0,90 lb	Apply this product preventatively or at the first sign of disease symptoms are visible. Reapply every 7 – 14 days. Use min 0,13 lb/acre for preventive effects and max 0,90 lb/acre for curative effects.

Crops	Target Disease	Application Method	Dose (min-max) per acre	Notes
	graminis) Rust (*Puccinia* spp.) (*Uromyces dactylidis*) Stripe Smut (*Ustilago striiformis*) Gray Snow Mold (Typhula Blight) *Waitea* spp. Anthracnose (*Colletotrichum cereale*) Dollar Spot (*Sclerotinia homoeocarpa*) Gray Leaf Spot (*Pyricularia grisea*) Southern Blight (*Sclerotium rolfsii* Sacc.)			

Application Rates for Post-Harvest Commodities

Post Harvest Crops	Disease, including:	Rate	Notes
Postharvest fruits and vegetables, including: Apples, Banana, Cherries, Citrus, Melon, Mango, Pears, Pineapple, Potatoes and Sweet potatoes	Blue mold, Dry rot, Gray mold, Green mold, Mucor rot, Silver scurf and Sour rot.	0,03 lb - 0,060 lb / Gallon	Apply once with a solution of 0,03lb to 0,06lb/gallon. To dissolve the KitoGreen®, use the method described in the "mixing" section above. The application may be made as a spray, a dip or a wash.

SEED TREATMENT USE DIRECTIONS

KitoGreen® can be applied as a seed dressing, seed soak or tuber dip at plant or in commercial seed treatments for suppression of nematode damage, soilborne diseases, promote seed germination, enhance seedling vigor and seedling growth, and increase root growth. Apply KitoGreen® as a water-based slurry with other registered seed treatments insecticides, nematicides, fungicides, through standard slurry or mist type commercial seed treatment equipment at a concentration of 2% KitoGreen in water acidified at pH of 3,5 or below.

Mixing Instructions: Prepare no more mixture than is required for the immediate operation. Agitate the solution vigorously during mixing and application. Mechanical mixing is recommended for proper mixing of KitoGreen® mixtures. For seed treatment apply 3 – 50 grams of KitoGreen per 100 lbs of seed.

Note: When using KitoGreen® in tank mixture with other seed treatment products, observe all direction for use, crops/sites, use rates, dilution ratios, precautions, and limitations that appear on the tank mix partner label. No label dosage might be exceeded and the most restrictive label precautions and limitations must be followed. This product should not be mixed with any product that prohibits such mixing.

For Use on the Following Crops

Bulb Vegetables: Garlic, Leeks, Onions (Bulb and Green), Shallots, and other bulb vegetable crops

Cereal Grains: Barley, Buckwheat, Grain Amaranth, Milo, Oats, Pearl Millet, Rye, Sorghum, Triticale, Wheat.

Cole Crops - (Brassicas): Broccoli, Broccoli Rabe, Brussels Sprouts, Cabbage, Chinese Broccoli, Chinese Cabbage (Bok Choy), Chinese Cabbage (Napa), Chinese Mustard Cabbage (Gai Choy), Cauliflower, Cavalo, Collards, Kale, Kohlrabi, Mizuna, Mustard Greens, Mustard Spinach, Rape Greens, and Turnip

Corn (Field Corn, Sweet Corn, Popcorn, and Corn Grown for Seed)

Cotton

Cucurbits: Chayote, Chinese Waxgourd, Cucumber, Citron Melon, Gherkin, Pumpkin and Watermelon; **Muskmelon**: Cantaloupe, Casaba, Crenshaw Melon, Golden Pershaw Melon, Honeydew Melon, Honey Balls, Mango Melon, Persian Melon, Pineapple Melon, Santa Clause Melon and Snake Melon; **Summer Squash:** Crookneck Squash, Scallop Squash, Straightneck Squash, Vegetable Marrow and Zucchini; **Winter Squash:** Acorn Squash, Butternut Squash, Calabaza, Gubbard Squash and Spaghetti Squash, and other cucurbit crops

Fruiting Vegetables: Eggplant, Okra, Pepper, Tomato, Tomatillo and Ground Cherry.

Leafy Vegetables: Arugula, Beet, Celery, Chervil, Cilantro, Corn Salad, Cress, Dandelion, Dock, Edible Chrysanthemum, Endive, Fennel, Garden Peas, Head Lettuce, Leaf Lettuce, Parsley, Purslane, Radicchio, Rhubarb, Spinach, Swiss Chard and Watercress.

Legumes, succulent and dried, (not including soybeans and peanuts)**:** Chick Peas, Dry Beans, Garbanzo Beans, Green Beans, Lentils, Lima Beans, Peas, Shell Beans, Snap Beans, Split Peas, and other legume crops.

Oil Seed Crops:(not including cotton, peanut or soybean)**:** Canola, Castor, Flax, Rapeseed, Safflower, Sesame and Sunflower.

Peanut.

Root, Tuber and Corm Vegetables: Beets, Carrots, Cassava, Ginger, Ginseng, Horseradish, Potato, Radish, Sugar beets, Sweet potato, Yams and Turnip.

Soybean.

CHEMIGATION USE DIRECTIONS

Apply this product only through sprinklers including center pivot, lateral move, end tow, side (wheel) roll, traveler, big gun, solid set, or hand move irrigation systems. Do not apply this product through any other type of irrigation systems. Do not connect an irrigation system (including greenhouse systems) used for biopesticide applications to a public water system.

Spray preparation

For a good solubility of the product, the water used to dissolve it must have a low pH which can be achieved by adding, for example, natural vinegar. In a clean bucket, prepare a solution with a pH of 4.5- 5.5 and dissolve the desired amount of the product. Stir long enough for the product to be and remain in dissolution. Pour this solution into a clean tank ½ filled. Add water to the desired volume and continue to stir.

GENERAL PRECAUTIONS FOR APPLICATIONS THROUGH SPRINKLER IRRIGATION SYSTEMS

Maintain continuous agitation in the mix tank during mixing and application to insure a uniform suspension. Greater accuracy in calibration and distribution will be achieved by injecting a larger volume for a more dilute solution per unit time. Crop injury or lack of effectiveness can result from non-uniform distribution of treated water. 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. Allow sufficient time for biopesticide to be flushed through all lines and all nozzles before turning off irrigation waters.

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 backflow.

The biopesticide 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 biopesticide injection pump when the water pump 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 biopesticide 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 biopesticides and capable of being fitted with a system interlock. Do not apply when wind speed favors drift beyond the area intended for treatment.

Do not apply when wind speed favors drift, when system connections or fittings leak, when nozzles do not provide uniform distribution or when lines containing the product must be dismantled and drained.

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage and disposal.

BIOPESTICIDE STORAGE: Store in cool and a dry place. Avoid freezing.

BIOPESTICIDE DISPOSAL: To avoid all wastes, use all material in this container by application according to label directions. If wastes cannot be avoided, offer remaining produc to a waste disposal facility or biopesticide disposal program (often such programs are run by state or local governments or by industry).

Do not contaminate water when disposing of equipment wash water or rinsate. Improper disposal of unused biopesticide, wash water or rinse water is a violation of federal law.

NONREFILLABLE CONTAINER HANDLING (GREATER THAN FIVE GALLONS):

Offer for recycling if available. Clean container promptly after emptying. Triple rinse as follows Empty the remaining contents into application equipment or a mix tank. Fill the contain 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 more times. Then offer for recycling if available or reconditioning if appropriate or puncture and dispose of in a sanitary landfill or by other procedure approved by local and state authorities.

CONDITIONS OF SALE, WARRANTY STATEMENT, DISCLAIMER

The directions for use of this product are believed to be adequate and must be followed carefully, it is impossible to eliminate all risks inherently associated with the use of this product. Crop injury, ineffectiveness, or other unintended consequences may result due to such factors as weather conditions, presence or absence of other materials, or the manner of use or application, all of which are beyond the control of KitoZyme, the manufacturer, or the seller.

Treatment of highly mechanical damage seed or seed of unknown low vigor and poor quality, may result in reduced germination and or reduction of seed and seedling vigor. Treat and conduct seed germination tests on a small portion of seed before committing to the total seed lot to a selected chemical treatment. Due to seed quality beyond the control of KitoZyme, no claims are made to guarantee germination of carry-over seed.

Note: Seller warrants that this product complies with the specifications expressed in this label. To the extent consistent with applicable law, KitoZyme makes no other warranties, and disclaims all other warranties, express or implied, including but not limited to warranties of merchantability and fitness for the intended purpose. To the extent consistent with applicable law, KitoZyme liability or default, breach or failure under this label shall be limited to the amount of the purchase price. To the extent consistent with applicable law, Seller shall have no liability for consequential damages.

KitoZyme makes no warranties of merchantability or fitness for a particular purpose or any other express or implied warranty except as stated above.

iMPACT SIX

Nematicide • Fungicide • Bactericide • Biostimulant

Impact SIX provides effective control/ suppression of plant-parasitic nematodes in the soil and of listed soil and foliar fungal pathogens. Impact SIX works with plant natural defense systems and soil biology to deter insect feeding, laying, and establishment as well as combat diseases caused by plant viruses.

Impact SIX can be applied as a foliar spray, in furrow, irrigation to turf, fruit, vegetables, ornamentals, row crops, nut crops, seed treatment and residential uses. Refer to package insert for details.

The active chitosan ingredient in Impact SIX stimulates the plant's ability to combat both biotic and abiotic stresses as well as contribute to the overall enhancement of plant health, productivity and stamina.

Active Ingredients:

Chitosan	6.0%
Other Ingredients: (Water, Citric Acid, Potassium Chloride, Potassium Sorbate)	94.0%
Total:	100.0%

The Pre-Harvest Interval (PHI): 0 days
Re-Entry Interval (REI): 0 days

☐ 1.0 Gallons / 3.785L ☐ 2.5 Gallons / 9.464L ☐ 5.0 Gallons / 18.928L

Made in U.S.A

Exclusively manufactured for:

Organisan corporation

P.O. Box 2085 • Carrollton, GA 30112
337-445-3657 • organisancorp.com

Lot #:

State Reg #:

Impact SIX is a 25(b) product qualifies for exemption from EPA registration under Federal Insecticide, Fungicide and Rodenticide Act (FIFRA)

Label Version: 2003-L-001
EPA Est. # 91888-LA-2

iMPACT SIX

Nematicide • Fungicide • Bactericide • Biostimulant

CAUTION / PRECAUCION - KEEP OUT OF REACH OF CHILDREN

May be irritating to eyes and skin. Do not get in eyes or on clothing. Wear goggles or face shield. After product is diluted in accordance with the directions for use, goggles or face shield is not required. 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.

FIRST AID		HOT LINE NUMBER
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 treatment advice.	Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact **1-800-222-1222** for emergency medical treatment information.

ADDITIONAL INFORMATION

See package insert for directions for use, application guidance and target species information. Refer to SDS for specific Safety and First Aid information.

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal. Store in a cool dry place. Avoid freezing. To avoid wastes, use all material in this container by application according to label directions. If wastes cannot be avoided, offer remaining product to a waste disposal facility or pesticide disposal program. Nonrefillable container. Do not reuse or refill this container. Triple rinse as follows: Empty the remaining contents into application equipment or mix tank and drain for 10 seconds after the flow begins to drip. Fill the container 1/4 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 if available, or puncture and dispose of in a sanitary landfill or by incineration. Do not burn unless allowed by state and local ordinances.

NOTICE ON CONDITIONS OF SALE

By using this product, user or buyer accepts the following Conditions, Disclaimer of Warranties and Limitations of Liability. The directions for use of this product are believed to be adequate and must be followed carefully. However, it is impossible to eliminate all risks associated with the use of this product. Crop injury, ineffectiveness or other unintended consequences may result because of such factors as weather conditions, presence of other materials, or the manner of use or application, all of which are beyond the control of Seller. All such risks shall be assumed by the user or buyer. To the extent consistent with applicable law, Seller makes no other warranties, express or implied, of merchantability or of fitness for a particular purpose or otherwise, that extend beyond the statements made on this label. No agent of Seller is authorized to make any warranties beyond those contained herein or to modify the warranties contained herein. To the extent consistent with applicable law, Seller disclaims any liability whatsoever for special, incidental or consequential damages resulting from the use or handling of this product. To the extent consistent with applicable law, the exclusive remedy of the user or buyer for any and all losses, injuries or damages resulting from the use or handling of this product, whether in contract, warranty, tort, negligence, strict liability or otherwise, shall not exceed the purchase price paid or at Seller election, the replacement of product.

Exclusively manufactured for: Organisan Corporation • P.O. Box 2085 • Carrollton, GA 30112 • 337-445-3657 • organisancorp.com

Tidal Grow®
SPECTRA

Fungicide, Bactericide, and Nematicide Liquid Concentrate

Tidal Grow® Spectra aids in the control of agricultural fungal diseases, bacterial diseases, viral diseases, and insect pests while boosting plants' natural defense mechanisms and stimulating growth and vigor.

Active Ingredient: Chitosan	5.75%
Inert Ingredients: Vinegar, Water	94.25%
Total	100.0%

CONTENTS: ❑ 4 x 1 Gallon ❑ 2 x 2.5 gallon ❑ 265 gallon tote

Contains 0.496 lbs chitosan/gallon Spectra weighs 8.62 lbs/gallon

CAUTION - KEEP OUT OF REACH OF CHILDREN

May cause eye and skin irritation. Avoid contact with skin and eyes. Wear safety glasses or goggles and chemical-resistant gloves when mixing or handling product. Wash thoroughly with soap and water after handling and before eating, drinking, chewing gum, using tobacco, or using the toilet.

Tidal Vision Products, Inc. DBA Tidal Grow® AgriScience
3710 Iron Gate Road, Bellingham, WA 98226
TidalGrowAg.com | +1 360-603-7676

FOR USE IN U.S. EXCEPT FOR INDIANA, MONTANA, and CALIFORNIA.

Tidal Grow® AgriScience

FIRST AID

IF INGESTED	Clean mouth with water and afterward drink plenty of water.
IF ON SKIN OR CLOTHING	Remove contaminated clothing. Rinse skin with soap and water.
IF INHALED	Remove to fresh air.
IF IN EYES	Rinse thoroughly with water for at least 15 minutes, lifting lower and upper eyelids. Remove contact lenses, if present, after the first 5 minutes.

STORAGE AND DISPOSAL:

Do not contaminate water, food or feed by storage or disposal. Store in the original container in a cool, dry area away from children and pets. Do not reuse empty container. If empty: Offer for recycling if available or discard in a sanitary landfill. If partly filled: Call your local solid waste agency for disposal instructions. Never place unused product down any indoor or outdoor drain.

MANUFACTURED BY:

Tidal Vision Products, Inc.
DBA Tidal Grow AgriScience
3710 Iron Gate Road
Bellingham, WA 98226
TidalGrow Ag.com

This 25(b) product is exempt from registration with the Federal Environmental Protection Agency under FIFRA regulations.

PRODUCT INFORMATION: When used as directed, Tidal Grow® Spectra can improve plant vigor and quality, make plants more resistant to infection, reduce the negative effects of environmental stressors, and provide protection against pathogens including plant parasitic nematodes, diseases, bacteria, and insects.

TARGET PESTS:

Fungi and Oomycetes	Alternaria, Anthracnose, Armillaria, Aspergillus, Botrytis, Brown Rust, Cladosporium, Coleoptera, Colletotrichum, Curvularia, Downy Mildew, Fusarium, Macrophomina, Melanose, Monilinia, Phoma (onion pink root rot), Phomopsis, Phytophthora, Powdery Mildew, Pythium, Rhizoctonia, Sclerotinia, Sclerotium, Sooty Mold, Stromatinia (Brown patch), Tar Spot, Verticillium
Bacteria	Agrobacterium, Bacterial Blast, Clavibacter, Erwinia, Pectobacterium, Pseudomonas, Xanthomonas
Viruses	Mosaic viruses and Potato Virus X
Insects*	Aphids, Borers, Cereal Leaf Beetle, Colorado Potato Beetle, Corn Borers, Corn Earworm, Corn Root Maggots, Crickets, Thrips, Corn Rootworm, Diamondback Moth, Grasshoppers, Leaf Miners, Mealy Bugs, Mites, Pea Weevils, Plant Bugs, Pine Beetles, Psyllids, Slugs, Snails, Stink Bugs, Sugarcane Aphids, White Flies, Wireworms
Nematodes	Gall nematode (Anguina spp.), Guava nematode (Meloidogyne spp.}, Potato cyst nematode (Globodera spp.}, Reniform nematode (Rotylenchulus spp.), Root-knot nematode (Meloidogyne spp.), Root-lesion nematode (Pratylenchus spp.), Soybean Cyst Nematode (Heterodera spp.), Stem nematode (Ditylenchus spp.}, Sting nematode (Belonolaimus spp.)

*Tidal Grow Spectra provides indirect control of insects by stimulating plant defense pathways (ISR) which deter insects from feeding on the crop and prevent insect pest populations from growing to infestation levels.

NOTE TO USER: Unintentional consequences such as crop injury may result due to environmental or growing conditions, manner of use, or application. Because plant tolerance of pesticides varies as conditions vary, treat a few plants under conditions expected to be encountered and observe for plant damage prior to full-scale application to a large number of plants.

Multi-state:
SPC1USA.0125
01.2025

DIRECTIONS FOR USE: ⬇ APPLICATION RATES: ➡

Tidal Grow® Spectra can be used as a foliar spray, soil drench, root dip, in-furrow or can be applied via chemigation methods (such as center pivot, drip/trickle, sprinkler, etc).

Tidal Grow® Spectra can be applied to crops at any time during the growing season including preplant, preemergence, post emergence, and in-season, up to and including the day of harvest.

The recommended concentration and rate of application depends on crop and severity of the pest or disease. Test results have shown that this product can increasingly suppress pests and pathogens at high doses; whereas tests results have shown the benefits to plant health and vigor at lower doses.

For best results apply the product early in the morning or late in the afternoon.

Tidal Grow® Spectra is compatible with most chemical fungicides, insecticides and fertilizers. The pH of the final solution should be below 7 for best results; perform a compatibility jar test prior to mixing with other chemicals - especially for concentrated aerial applications. Combining Spectra with anionic polymers tends to cause clumping, gelling, or settling. Example: Spectra is incompatible with ammonium polyphosphate fertilizers (10-34-0 and 11-37-0). Contact your sales rep for more information on compatibility.

For best results, store out of direct sunlight at room temperature.

ENVIRONMENTAL HAZARDS

Not for aquatic use. 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 cleaning equipment or disposing of equipment wash waters.

IMPORTANT: Additional Operating Instructions for Chemigation for Washington State. Review your state and local regulatory requirements before applying any agricultural chemical through an irrigation system. Refer to the SUPPLEMENTAL LABELING FOR CHEMIGATION APPLICATIONS for additional use requirements and restrictions.

Scan the QR code for Supplemental Labeling for Chemigation Applications

Crop Grouping	Application Method	Application Timing	Rate	Comments
Soybeans	In-Furrow or Soil Treatment	At planting or pre-plant	Apply 6-22 fl oz of product per acre	Can be applied via spray, chemigation, drip, or other means.
	Foliar (ground spray, pivot, etc)	Starting as early as V3-V5	Apply 6-22 fl oz of product per acre	Use at least 10 gallons of total spray volume per acre. Re-apply once every 2 weeks or as needed.
	Foliar (aerial)	Starting as early as V3-V5	Apply 6-22 fl oz of product per acre	Use at least 2 gallons of total spray volume per acre. Re-apply once every 2 weeks or as needed.
Corn (fields, sweet, popcorn)	In-Furrow or Soil Treatment	At planting or pre-plant	Apply 6-22 fl oz of product per acre	Can be applied via spray, chemigation drip, or other means.
	Foliar (ground spray, pivot, etc)	Starting as early as V2-V4	Apply 6-22 fl oz of product per acre	Use at least 10 gallons of total spray volume per acre. Re-apply once every 2 weeks or as needed.
	Foliar (aerial)	Starting as early as V2-V4	Apply 6-22 fl oz of product per acre	Use at least 2 gallons of total spray volume per acre. Re-apply once every 2 weeks or as needed.
Cereal Grains (non-corn, such as Barley, Wheat, Buck-wheat, Rye, Millet, Oats, Rice, Sorghum, Triticale)	In-Furrow or Soil Treatment	At planting or pre-plant	Apply 6-22 fl oz of product per acre	Can be applied via spray, chemigation drip, or other means.
	Foliar (ground spray, pivot, etc)	Starting as early as 3-5 leaf stage	Apply 6-22 fl oz of product per acre	Use at least 10 gallons of total spray volume per acre. Re-apply once every 2 weeks or as needed.
	Foliar (aerial)	Starting as early as 3-5 leaf stage	Apply 6-22 fl oz of product per acre	Use at least 2 gallons of total spray volume per acre. Re-apply once every 2 weeks or as needed.
Cotton	In-Furrow or Soil Treatment	At planting or pre-plant	Apply 6-22 fl oz of product per acre	Can be applied via spray, chemigation drip, or other means.
	Foliar (ground spray, pivot, etc)	Starting as early as 14 days after emergence	Apply 6-22 fl oz of product per acre	Use at least 10 gallons of total spray volume per acre. Re-apply once every 2 weeks or as needed.
	Foliar (aerial)	Starting as early as 14 days after emergence	Apply 6-22 fl oz of product per acre	Use at least 2 gallons of total spray volume per acre. Re-apply once every 2 weeks or as needed.
Roots/Tubers (such as cassava, potatoes, sweet potatoes, and yams)	In-Furrow or Soil Treatment	At planting or pre-plant	Apply 6-22 fl oz of product per acre	Can be applied via spray, chemigation drip, or other means.
	Foliar (ground spray, pivot, etc)	Starting as early as 14 days after emergence	Apply 6-22 fl oz of product per acre	Use at least 10 gallons of total spray volume per acre. Re-apply once every 2 weeks or as needed.
	Foliar (aerial)	Starting as early as 14 days after emergence	Apply 6-22 fl oz of product per acre	Use at least 2 gallons of total spray volume per acre. Re-apply once every 2 weeks or as needed.
Forests and Tree Farms (such as Christmas trees, natural forests, ornamental trees)	In-Furrow or Soil Treatment	At planting or pre-plant	Apply 6-22 fl oz of product per acre	Can be applied via spray, chemigation drip, or other means.
	Foliar (ground spray, pivot, etc)	Starting as early as 14 days after emergence	Apply 6-22 fl oz of product per acre	Use at least 10 gallons of total spray volume per acre. Re-apply once every 2 weeks or as needed.
	Foliar (aerial)	Starting as early as 14 days after emergence	Apply 6-22 fl oz of product per acre	Use at least 2 gallons of total spray volume per acre. Re-apply once every 2 weeks or as needed.
Citrus Fruits Grapefruits, Limes, Lemons, Oranges)	Soil Treatment	At planting or pre-plant	Apply 6-22 fl oz of product per acre	Can be applied via spray, chemigation drip, or other means.
	Foliar (ground spray, pivot, etc)	Starting as early as bud formation	Apply 6-22 fl oz of product per acre	Use at least 10 gallons of total spray volume per acre. Re-apply once every 2 weeks or as needed.
	Foliar (aerial)	Starting as early as bud formation	Apply 6-22 fl oz of product per acre	Use at least 2 gallons of total spray volume per acre. Re-apply once every 2 weeks or as needed.
Berries & Small Fruit (such as Aronia Berries, Blackberries. Blueberries, Currants, Elderberries, Gooseberries, Grapes, Huckleberries, Kiwifruits, Loganberries, Mulberries, Raspberries, Strawberries)	Soil Treatment	At planting or pre-plant	Apply 6-22 fl oz of product per acre	Can be applied via spray, chemigation, drip, or other means.
	Foliar (ground spray, pivot, etc)	Starting as early as budswell or budburst	Apply 6-22 fl oz of product per acre	Use at least 10 gallons of total spray volume per Re-apply once every 2 weeks or as needed.
	Foliar (aerial)	Starting as early as budswell or budburst	Apply 6-22 fl oz of product per acre	Use at least 2 gallons of total spray volume per Re-apply once every 2 weeks or as needed.
Flowers - Greenhouse and Nursery (such as Shade and Flowering Tree Starts, Woody Ornamentals, Hemp, Ornamental Flowers)	Soil Treatment or Root Dip	During any growth stage	Apply 1 tsp of product per 1000 sq ft of canopy	Can be applied via spray chemigation, drip, or other means.
	Foliar Spray	Up to one week before harvest	Apply 2 tsp of product per 1000 sq ft of canopy	Use minimum spray volume to cover foliage. Spray tops and bottoms of leaves for best results.
Tree Nuts (such as Almonds, Beech Nuts, Brazil Nuts, Butternuts, Cashews, Chestnuts, Hazelnuts, Hickory Nuts, Macadamia Nuts, Pecans, Walnuts)	Soil Treatment	At planting or pre-plant	Apply 6-22 fl oz of product per acre	Can be applied via spray, chemigation, drip, or other means.
	Foliar (ground spray, pivot, etc)	Starting as early as bud formation	Apply 6-22 fl oz of product per acre	Use at least 10 gallons of total spray volume per Re-apply once every 2 weeks or as needed.
	Foliar (aerial)	Starting as early as bud formation	Apply 6-22 fl oz of product per acre	Use at least 2 gallons of total spray volume per Re-apply once every 2 weeks or as needed.
Tree Fruits (non-citrus, such as Apples, Apricots, Avocados, Crabapples, Loquats, Nectarines, Oriental Pears, Peaches, Pears, Plums, Prunes, Quinces, Sweet Cherries, Tart Cherries)	Soil Treatment	At planting or pre-plant	Apply 6-22 fl oz of product per acre	Can be applied via spray, chemigation, drip, or other means.
	Foliar (ground spray, pivot, etc)	Starting as early as bud formation	Apply 6-22 fl oz of product per acre	Use at least 10 gallons of total spray volume per Re-apply once every 2 weeks or as needed.
	Foliar (aerial)	Starting as early as bud formation	Apply 6-22 fl oz of product per acre	Use at least 2 gallons of total spray volume per Re-apply once every 2 weeks or as needed.
Vegetables (such as Artichokes, Broccoli, Brussels sprouts, Cabbage, Carrots, Cauliflower, Cucumber, Eggplants, Garlic, Leafy Vegetables, Onion, Pumpkin, Squash)	In-Furrow or Soil Treatment	At planting or pre-plant	Apply 6-22 fl oz of product per acre	Can be applied via spray, chemigation, drip, or other means.
	Foliar (ground spray, pivot, etc)	Starting as early as 14 days after emergence	Apply 6-22 fl oz of product per acre	Use at least 10 gallons of total spray volume per Re-apply once every 2 weeks or as needed.
	Foliar (aerial)	Starting as early as 14 days after emergence	Apply 6-22 fl oz of product per acre	Use at least 2 gallons of total spray volume per Re-apply once every 2 weeks or as needed.
Legumes (non-soybean, such as Broad Beans, Chickpeas, Lentils, Peas, Pigeon Peas, Snap Beans, various Lupinus spp. beans)	In-Furrow or Soil Treatment	At planting or pre-plant	Apply 6-22 fl oz of product per acre	Can be applied via spray, chemigation, drip, or other means.
	Foliar (ground spray, pivot, etc)	Starting as early as 14 days after emergence	Apply 6-22 fl oz of product per acre	Use at least 10 gallons of total spray volume per Re-apply once every 2 weeks or as needed.
	Foliar (aerial)	Starting as early as 14 days after emergence	Apply 6-22 fl oz of product per acre	Use at least 2 gallons of total spray volume per Re-apply once every 2 weeks or as needed.
Turfgrass (such as SodFarms, Ornamental Lawns, Golf Courses) + Sugarcane (such as syrup canes, crystal canes, chewing canes)	Soil Treatment	At planting or pre-plant	Apply 6-22 fl oz of product per acre	Can be applied via spray, chemigation, drip, or other means.
	Foliar (ground spray, pivot, etc)	Starting as early as 14 days after emergence	Apply 6-22 fl oz of product per acre	Use at least 10 gallons of total spray volume per Re-apply once every 2 weeks or as needed.

WARHAMMER™

Nematicide – Fungicide - Bactericide

ACTIVE INGREDIENT:

Chitosan	10%
INERT INGREDIENTS	
Water, vinegar	90%
Total	100%

KEEP OUT OF REACH OF CHILDREN

CAUTION

See back panel for additional precautionary statements.

Net Contents: 2.5 gallon (9.25 L)

FIRST AID	
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 treatment advice.
HOTLINE NUMBER Have the product container or label with you when calling a poison control center, doctor or going for treatment. You may also contact 1-800-222-1222 for emergency medical treatment information.	

PRECAUTIONARY STATEMENTS

Hazards to Humans and Domestic Animals

CAUTION. Causes moderate eye irritation. Avoid contact with eyes. Wear safety glasses or goggles. 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.

DIRECTIONS FOR USE

WarHammer stimulates a plant's immune system enabling it to defend itself from pests and diseases. It can be used on all indoor and outdoor crops against nematodes, fungi, bacteria and some viruses. Soil diseases suppressed include *Fusarium, Rhizoctonia, Pythium, Phytophthora, Sclerotinia, Verticillium* and other soil borne diseases.

Foliar diseases effectively suppressed: Powdery and Downy Mildew, *Botrytis, Erwinia amylovora, Sclerotinia*, *Alternaria*, Monolinia, *Psuedomonas sp* including *P. syringae*, *Xanthomonas axonopodis* (citrus canker) and *Xanthomonas arboricola pv. Juglandis* and other foliar diseases.

Nematodes suppressed: Root knot nematode (*Meloidogyne spp.),* Root lesion nematode (*Pratylenchus spp.),* Reniform nematode *(Rotylenchulus spp.),* Sting nematode (*Belonolaimus spp.),* Stem nematode *(Anguina spp.)* and Citrus nematode *(Tylenchulus spp.).*

Viruses suppressed: Potato virus X (PVX), leaf curl virus; tomato mosaic, squash mosaic and tobacco mosaic virus

Compatibility

WarHammer dilutes easily and does not require agitation to keep suspended in a solution. WarHammer is compatible with most chemical fungicides, insecticides and fertilizers. Compatibility issues may occur with tank mixes of seaweed and humic acid products. Always do a small jar test prior to tank mixing with other products.

Application Instructions

Apply WarHammer throughout the growing season from early spring to late fall on all indoor and outdoor crops Apply with a minimum of 10-30 gallons of water per acre and a maximum of 200+ gallons of water per acre.
As a soil application, apply at any time during the growing season (pre or post plant as well as post harvest). Applications may be either broadcast over an entire field, in furrow or banded into planting rows.
As a foliar treatment, apply initial application prior to onset of disease season or at any time during the season. Spray wet to runoff.

Pre-Harvest Interval (PHI) and Re-Entry Interval (REI):

There is no REI and no PHI for this product.

FOR SMALL APPLICATIONS:
Use 1 oz per 10 gallons/3mL per gallon. Apply as a spray, soil drench, seed treatment or mixed in nutrient tank.

TURF
Golf Course Tees, Greens and Fairways; Commercial and Residential Lawns; Sod Farms, Athletic Fields, Parks, Cemeteries and Similar Sites
Soil Drench Application or spray equipment: Apply at a rate of 16 oz per acre for initial application or problem areas. Apply maintenance applications of 8 oz. per acre every 2 to 8 weeks through season.
For spray equipment, mix with appropriate amount of water (2-4 gallons per 1000 sq. ft.). Water in immediately after application for 3-6 minutes.
Foliar Spray Application: Apply at a rate of 16 oz per acre for initial application or problem areas. Apply maintenance applications of 8 oz. per acre every 2 to 8 weeks through season.

AGRICULTURE FIELD PRODUCTION
Soil Treatment at Planting:
Use at planting, in-furrow, seeding, or transplant. Apply 4-12 oz. of WarHammer per acre.
Soil Treatment Post Planting:
Apply 4-12 oz per acre.
Seed Treatment:
Prior to planting, dissolve 2-18 oz in 4 oz of water and spray directly on 100 lbs of seed.
Foliar Treatment:
Use 4-12 oz in 20-150 gallons of water per acre. Reapply every 7-14 days depending on disease pressure and environmental conditions.
GREENHOUSE, NURSERY AND CONTROLLED ENVIRONMENT
Soil Drench Mix 4-12 oz 100 gallons of water to create solution. Apply solution as a drench to plants/growing media until soil is saturated without creating run-off.
Greenhouse Foliar Sprays
Use 4-12 oz WarHammer per 100 gallons of water. Apply to foliage and blossoms every 7- 14 days depending on disease pressure. Spray wet to run-off.

POST HARVEST APPLICATION
Use a dilution rate of 4-12 oz per 100 gallons of water to treat harvested crop.

WARHAMMER MAY BE USED ON ALL CROPS INCLUDING, BUT NOT LIMITED TO:
Agronomic Field and Row Crops: Buckwheat, corn (all types), cotton, canola, safflower, sunflower, succulent and dry peas, peanuts, soybeans and other agronomic field and row crops
Alfalfa Hay and Forage: Alfalfa, clover, vetch, trefoil
Small Grains: Rye, rice, sorghum, millet and other small grains
Corn: Popcorn, seed corn, sweet corn and other corn crops
Cucurbit Vegetables: Cucumbers, melons, gourds, squash, cantaloupe, and other cucurbits
Fruiting Vegetables: Eggplant, sweet peppers, hot peppers, tomatoes, tomatillos and other fruiting vegetables
Herb, Spices and Mints: Sage, rosemary, thyme, peppermint, dill, basil, oregano and other herbs and spices
Leafy Vegetables and Cole Crops: Broccoli, brussels sprouts, cabbage, cauliflower, celery, kale, lettuce, spinach and others
Legume and Vegetable Crops: Snap and dry beans, lentils, succulent and dry peas, peanuts, soybeans and others
Root/Tuber and Bulb Crops: Garlic, onions, white potatoes, sweet potatoes, carrot, ginger, ginseng, horseradish, turnip, beets, radish and others
Berry Crops: Blueberries, blackberry, raspberry, loganberry, huckleberry, gooseberry, elderberry, currant, caneberry and others
Citrus: Orange, grapefruit, lemon, tangerine, tangelo, lime, pummelo and other citrus crops
Grape: Wine grapes, table grapes, raisins and other grape crops
Ornamental: All crops grown for ornamental purposes
Pome Fruit: Apple, crabapple, pear, quince, mayhaw and other pome fruit
Stone Fruit: Apricot, cherry, nectarine, peach, plum, prune and other stone fruit
Turf: All types of turf, lawns and ornamental grasses
Tree Nuts: Almond, pistachio, pecan, walnut, filberts and other tree nuts
Tropical Fruits: Agave, avocado, mango, papaya bananas, plantains and other tropical fruits
OTHER CROPS: Sugar Cane, Tobacco, Asparagus, Hops, Watercress, Mushrooms, Ginseng, Olives, Hemp, All crops grown for seed, Coffee

STORAGE AND DISPOSAL

Do not contaminate water, food, or feed by storage or disposal.

Pesticide Storage: Store in a cool, dry place at or below 68°F (20°C). Store in original container only. Keep container tightly closed, when not in use.
Pesticide Disposal: Wastes resulting from use of this product must be disposed of on site or at an approved waste disposal facility.
Container Handling: Nonrefillable container; do not reuse or refill this container. Offer for recycling, if available. Triple rinse container promptly after emptying.
Triple rinse as follows: Fill container 1/4 full with water and recap. Agitate vigorously. Follow Pesticide Disposal instructions for rinsate disposal. Drain for 10 seconds after the flow begins to drip. Repeat procedure two more times. Then of.

Optimum storage temperature is 33°F to 95°F.

Manufactured by:

Blacksmith BioScience LLC
25018 Spring Ridge Dr
Spring TX 77386
www.blacksmithbio.com
(409) 746-8600

LIMITED WARRANTY/DISCLAIMER

Manufacturer warrants that this product is suited for the labeled uses when applied according to label directions. Manufacturer makes no warranty of merchantability. To the extent consistent with applicable law, there are no warranties that extend beyond the description on this label and in no event shall manufacturer be liable for any consequential damages.

This product has not been registered by the United States Environmental Protection Agency. Blacksmith BioScience represents that this product qualifies for exemption from registration under FIFRA Section 25(b).

BEST IF USED BY:

- For protection against damage caused by certain plant pathogenic nematodes (on turf and ornamentals)
- The Nematicide you have been waiting for!
- Are you fighting nematode hot spots? Try Chitocide!
- It works fast
- No respirator [required] [for application]
- Spray over the top of this with anything!
- Images of target pest (i.e. nematode) with circle-backslash symbol (no sign, prohibition sign)

Appendix B - Science Review in Support of the Addition of Chitosan (Poly-D-Glucosamine) to the List of Minimum Risk Pesticides (MRPs) Contained in 40 CFR 152.25(f), U.S. Environmental Protection Agency (2020)

Active Ingredient(s): Chitosan
PC Code(s): 128930
Type of Review: Product Chemistry, Human Health, Non-target Organisms and Environmental Fate

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

MEMORANDUM

DATE: 08/23/2019

OFFICE OF CHEMICAL SAFETY
AND POLLUTION PREVENTION

SUBJECT: Science review in support of the addition of Chitosan (Poly-D-Glucosamine) to the list of minimum risk pesticides (MRPs) contained in 40 CFR 152.25(f)

Chemical Class:	Biochemical
PC Code:	128930
CAS Number:	9012-76-4
Active Ingredient Tolerance/Exemption:	40 CFR 180.1072

FROM: Russell S. Jones, Ph.D., Senior Scientist
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THROUGH : Shannon L. Borges, Chief
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TO: Linda Hollis, Chief
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Biopesticides & Pollution Prevention Division (7511P)

ACTION REQUESTED

Tidal Vision Products, LLC submitted a petition requesting the addition of Chitosan (Poly-D-Glucosamine) to the list of minimum risk pesticides (MRPs) contained in 40 CFR 152.25(f). In support of the petition, the applicant submitted a letter outlining the seven criteria that were considered in the creation of the MRP list and how Chitosan fulfills each of the seven criteria.

Active Ingredient(s): Chitosan
PC Code(s): 128930
Type of Review: Product Chemistry, Human Health, Non-target Organisms and Environmental Fate

BACKGROUND

Chitosan (Poly-D-Glucosamine; Figure 1) is a de-acetylated form of the naturally-occurring polysaccharide, Chitin (Poly-N-Acetyl-D-Glucosamine; Figure 2). Both substances are comprised of chains of glucosamine molecules that are structurally-related to cellulose (Figure 3). Chitin is a biopolymer second only to cellulose (Figure 3) in worldwide abundance. Chitin is found in numerous organisms, the most plentiful of which are the shells of marine crustaceans; it is also found in insect exoskeletons and fungal cell walls (FDA GRN No. 443, 2012; review by Kurita, 2006). Chitosan also occurs naturally and is formed by chitin deacetylases that have been identified in marine bacteria, fungi, and insects (review by Zhao et al., 2010). Chitosan is a heterogeneous substance and, depending on the degree and duration of deacetylation during the manufacturing process, can be defined as chitin that has been sufficiently deacetylated to form soluble amine salts (MRID 47362201 and references therein).

Chitin is the sole raw material used for the commercial manufacture of Chitosan. The largest commercial sources of Chitin are marine crustaceans (e. g., shrimp, crab, prawn, lobster, and krill) obtained from the world oceans as a food source, with about 75% of the total weight ending up as seafood "waste" products which are disposed at sea, burned, landfilled, or left to spoil (Bellich et al., 2016; Hamad et. al., 2015; Younes and Rinaudo, 2015). Therefore, the commercial extraction of chitin and chitosan and their conversion into commercial products provides a pathway for reducing this waste stream in the environment.

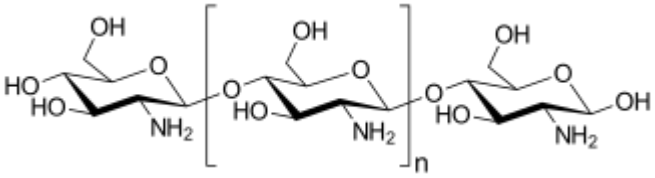

Figure 1. Structure of Chitosan

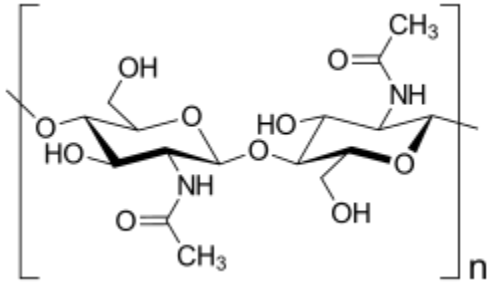

Figure 2. Structure of Chitin

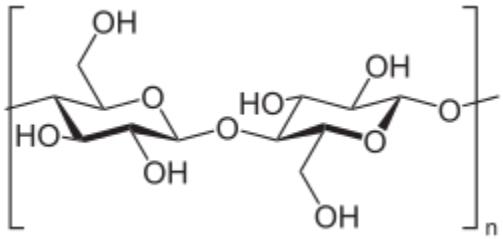

Figure 3. Structure of Cellulose

Extraction of Chitin and its conversion to Chitosan: The percentages of the three major components of crustacean shells are variable, depending upon species and seasons, but they are comprised of calcium

carbonate (20%–50%), proteins (20%–40%) and chitin (15%–40) (review by Bellich et al., 2016; Bolat et. al. 2010; Hamad et. al., 2015; Hong et. al., 1989). Chitin is first extracted from crushed/powdered crustacean shells by (1) demineralizing the shells enzymatically (via lactic acid) or with hydrochloric acid to remove calcium carbonate and calcium phosphate; (2) treatment with proteases or with sodium hydroxide to remove proteins; and (3) a decolorization extraction with organic solvents to remove pigments (e. g., carotenoids). Chitosan is prepared from chitin by de-acetylation, either enzymatically (via naturally-occurring deacetylases) or by treatment with 40-50% sodium hydroxide (review by Hamed et. al., 2016).

IA. FACTORS CONSIDERED FOR AMENDING 40 CFR 152.25 TO EXEMPT SUBSTANCES FROM REGULATION UNDER FIFRA (61 Federal Register 8876, March 6, 1996)

The following seven factors described at 61 FR 8876 (March 6, 1996) are considered when substances are added to the list of substances exempted from FIFRA requirements as pesticides:

1. Whether the pesticidal substance is widely available to the general public
2. If it is a common food or a constituent of a common food
3. If it has a nontoxic mode of action
4. If it is recognized by the Food and Drug Administration as safe
5. If there is no information showing significant adverse effects
6. If its use pattern will result in significant exposure
7. If it is likely to be persistent in the environment.

Additionally, this FR notice clarified that the factors are not meant to be absolute criteria and certain ones may be unsupported for some substances. However, taken as a whole, the EPA believes that these factors indicate that substances proposed for this list will not pose a risk that warrants regulation under FIFRA.

IB. THE FOLLOWING SPECIFIC CRITERIA WERE USED TO QUALIFY SUBSTANCES TO BE EXEMPT FROM THE REQUIREMENTS OF FIFRA, AND THEIR APPLICATION TO CHITOSAN

1. <u>Widely available to the general public</u>.

   Chitosan has a wide range of agricultural. biopharmaceutical, biomedical, cosmetic, textile, and food additive applications (review by Bellich et. al., 2016; review by Hamad et. al., 2016; US

EPA, 2007). Chitosan is used as a food preservative to inhibit microorganism growth and extend shelf life (El-Diasty et. al. 2012); as a component of edible, biodegradable, antimicrobial films applied to foods and food packaging (Sinha et. al., 2012). As an antimicrobial pesticide, chitosan employs anti-bacterial properties to protect fabrics from bacterial and fungal growth (US EPA, 2007). It also is used in flocculating agents for water and waste treatment, chelating agents for removal of traces of heavy metals from aqueous solutions, coatings to improve dyeing characteristics of glass fibers, wet strength additives for paper, adhesives, photographic and printing applications, thickeners, and fibers and films (review by NTP, 1999). Chitosan has several biomedical applications and is a hemostatic agent that is hypoallergenic and is known to possess anti-bacterial properties (US EPA, 2007), and it also is useful in stimulating plants to resist pathogens. The diverse routes of exposure to the general public via agricultural. biopharmaceutical, biomedical, cosmetic, textile, and food additive applications demonstrates that chitosan is a common substance in the environment. The lack of reports of adverse human health effects, despite the widespread exposure to chitosan, supports the conclusion that there are minimal risks to humans and the environment if chitosan is to be used as a minimum risk pesticide.

2. Common foods or constituents of common foods.

Although chitosan is not a food, it has numerous food related uses. It may be present in foods as a food preservative to inhibit microorganism growth and extend shelf life (El-Diasty et. al. 2012); as a component of edible, biodegradable, antimicrobial films applied to foods and food packaging (Sinha et. al., 2012); as a dietary supplement and excipient in medicines (NTP, 1999); and numerous uses in dairy production (Evdokimov et. al., 2015). Chitosan has been widely used as an over-the-counter dietary supplement as a putative “fat blocker” and as a diluent and vehicle for orally administered medicines (NTP, 1999) with no reported adverse health effects. Chitosan was granted an exemption from the requirements of tolerances on all food commodities in 1995, and this decision was re-assessed in 2002; no changes were made to the tolerance exemption at that time.

3. Nontoxic mode of action.

In agricultural practice, Chitosan acts as an induced resistance promoter characterized by its ability to stimulate internal mechanisms of treated plants to resist plant pathogens (US EPA, 2007). As an antimicrobial pesticide, Chitosan employs antibacterial properties to protect fabrics from bacterial and fungal growth (US EPA, 2007). Antibacterial modes of action may include, but are not limited to, disruption of bacterial cell membranes or cell wall integrity, inhibition of respiration, interactions with bacterial DNA/RNA, and/or physical deposition (smothering) (review by Malerba and Cerana, 2016). No known adverse effects have been reported for humans and other non-target organisms following agricultural, biopharmaceutical, biomedical, cosmetic, textile, and food additive applications of products containing chitosan.

4. Recognized by the Food and Drug Administration as safe.

A search of the FDA inventory of Generally Recognized As Safe (GRAS) Notices indicates that Chitosan does not have FDA GRAS status under 21 CFR 170.36. Three notices were made to FDA's CFSAN/Office of Food Additive Safety for shrimp-derived Chitosan (GRN Nos. 73, 170, and 443) but FDA ceased to evaluate the notices at the request of the notifier in 2002, 2005, and 2013, respectively. One notice was made to FDA's CFSAN/Office of Food Additive Safety for Chitosan from *Aspergillus niger* (GRN No. 397) in 2011, for which FDA had no questions. As of the 06/14/2019 update of the FDA GRAS Notices web page, FDA has not made a final determination on the GRAS status of the GRN Nos. 73, 170, 397, and 443. (https://www.accessdata.fda.gov/scripts/fdcc/?set=GRASNotices&sort=GRN_No&order=DESC&startrow=1&type=basic&search=Chitosan) (Accessed 08/15/2019).

5. No significant adverse effects to humans or the environment.

Chitosan has minimal acute toxicity and is classified in Toxicity Category IV for acute oral toxicity, acute dermal toxicity, acute inhalation toxicity, acute eye irritation, and acute dermal irritation; it is not a skin sensitizer (EPA, 2016). No toxic effects were observed in a six-month study wherein male and female rats were dosed with up to 5200 mg Chitosan/kg-bw in the diet, although decreased fat digestion and depletion of some fat-soluble vitamins was reported (NTP, 2017); this observation is consistent with the dietary supplement use of Chitosan as a "fat blocker." In addition, chitosan has been shown to have anti-genotoxic and anti-carcinogenic properties (NTP, 1999). Intentional oral ingestion of chitosan containing foods, dietary supplements, and medicines has been estimated to be up to 20 g per person per day (NTP, 1999).

Although the source material for chitosan (chitin) is obtained from shellfish, industrially-manufactured chitosan is not likely to have allergenicity concerns, provided that all animal proteins are removed during the extraction and purification process from chitin. The harsh manufacturing process that involves demineralization with hydrochloric acid, protein removal with sodium hydroxide and a final extraction with organic solvents (review by Hamed et. al., 2016) is likely sufficient to remove and/or denature any proteins, fats and other contaminants of allergenic or other toxic concern (review by Muzzarelli, 2010). There are few credible reports of allergic responses to Chitosan exposure. One study in Japan noted that a "47-year-old female developed systemic urticaria and difficulty breathing" following oral ingestion of a chitosan-containing dietary supplement, but the purity of the Chitosan used in the study was unclear, and it appeared to be derived from a non-shellfish source (Kato et. al., 2005). Conversely, it has more recently been reported that oral administration of chitosan has been demonstrated to protect mice against peanut-induced allergic response (Bae et. al., 2013). Widespread use of chitosan in agricultural, pharmaceutical, biomedical, cosmetic, textile, and food additive applications (review by Bellich et. al., 2016; review by Hamad et. al., 2016; NTP, 1999; Sinha et. al., 2012; US EPA, 2007) without reports of adverse effects, indicates that there is little concern for allergenic response following exposure to highly purified chitosan.

No adverse effects are expected when non-target organisms are exposed to chitosan. Chitosan is produced naturally in several species of marine bacteria, fungi, and some insects and may serve as a protective mechanism against pathogen infection (Zhao, et. a., 2010). Positive effects on plant growth and the suppression of plant pathogens in the soil rhizosphere and plant foliage have been reported by numerous authors (reviews by Hassan and Chang, 2017; and Malerba and Cerana, 2018). A search of the EPA's Incident Data System database did not reveal any human health or ecological incidents pertaining to the use of chitosan as a pesticide.

6. Negligible human or environmental exposure.

Non-pesticidal exposure of humans and the environment to Chitosan is likely to far exceed exposure from pesticidal sources. Non-pesticidal exposure to Chitosan is relatively widespread and continuous based on a diverse range of uses in agriculture, pharmaceuticals, medicine, cosmetics, textiles, as a food additive (review by Bellich et. al., 2016; El-Diasty et. al. 2012) and as an anti-microbial agent (US EPA, 2007).

In the Chitin and Chitosan Summary Document for Registration Review (US EPA 2007), it was determined that based on reviews of human health and non-target organism exposure, and the summary risk assessments that were conducted when the first pesticides containing these active ingredients were originally registered, the Agency anticipates that no additional human health effects or non-target organism data will be required for either Chitin or Chitosan. The reviews indicate that data were sufficient to fulfill all current biochemical pesticide toxicology data requirements for both Chitin and Chitosan and that that no new data or human health risk and environmental risk assessments will be necessary for either Chitin or Chitosan.

7. Non-persistence.

The environmental fate of chitosan (poly-D-glucosamine) has not been thoroughly investigated, although many soil types have been reported to contain chitosan-degrading bacteria. The apparent ubiquitous presence of Chitosan-degrading bacteria in diverse soil types indicates that Chitosan may be readily degraded in soils and may be important it the biocycling of chitin and chitin derivatives in the environment (Davis and Eveleigh, 1984; Sawaguchi et. al., 2015; review by Somashekar and Joseph, 1996). Few studies were identified that assessed the rates of Chitosan biodegradation in soil. In one study using sandy and silty soils (Sawaguchi et. al., 2015), it was observed that Chitosan added to silty soil dissipated by 50% after 10 days incubation at 25°C, and was non-detectable after 30 days, and the dissipation was associated with the presence of actinobacteria belonging to genera *Streptomyces* and *Kitasatospora,* populations of which increased proportionally to the decrease in chitosan content. The chitosan content of the sandy soil as well as that of the soil microorganisms was relatively unchanged under the same experimental conditions, suggesting that the sandy soil contained fewer chitosan-degrading microorganisms. Another study, using sheep-grazed

agricultural soils in the UK (Roberts, Bol, and Jones, 2007) and radio-labeled glucosamine it was reported that glucosamine removal from soil solution was primarily by microbial processes and that the half-life in soil solution ranged from 1-3 hours. The results of the two studies suggest that the low "free" concentrations of glucosamines (such as Chitosan) in soils is due to rapid degradation by soil microbes.

II. RISK ASSESSMENT

Chitosan is widely used in agricultural, biopharmaceutical, biomedical, cosmetic, textile, and food additive applications with no known reports of adverse effects to humans and the environment. Based on information obtained from studies submitted to the Agency in support of product registrations, and from the open technical literature, chitosan has been shown to have minimal acute and subchronic toxicity, is not a sensitizer or an allergen, and is not genotoxic, mutagenic, or carcinogenic. In addition to exposure to humans and the environment via intentional uses of chitosan-containing products, naturally-occurring chitosan, as well as its sole natural source, chitin, are widespread in the environment in the form of shells of aquatic organisms (e. g. marine and freshwater crustaceans and molluscs), soil microorganisms, and insect exoskeletons. The apparent ubiquitous presence of chitosan-degrading bacteria in soils indicates that chitosan is readily biodegraded in soils and may be important in the biocycling of chitin and chitin derivatives (likely derived from soil fungi) in the environment. Chitosan applied as a minimum risk pesticide likely would not persist in the environment due to ubiquitous presence of chitosan-degrading microorganisms.

This assessment agrees with the Chitin and Chitosan Summary Document for Registration Review (US EPA, 2007), where it was determined that the Agency anticipates that no additional human health effects or non-target organism data will be required for either Chitin or Chitosan. Based on all of the information available to the Agency, there are no risk concerns for human health or the environment if chitosan is intended for use as a minimum risk pesticide.

III. CONCLUSIONS

There is sufficient scientific evidence to support a conclusion of minimum risk for chitosan. This conclusion is supported by information contained in Agency reviews for the registration of EPA-registered products containing Chitosan as an active ingredient, and human health and environmental information contained in the open technical literature.

IV. REFERENCES

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Active Ingredient(s): Chitosan
PC Code(s): 128930
Type of Review: Product Chemistry, Human Health, Non-target Organisms and Environmental Fate

cc: R. S. Jones, G. Sinclair, S. L. Borges, L. Hollis; BPPD Science Review File, IHAD/ARS
R. S. Jones, Ph.D., Senior Scientist, FT, PY-S: 08/21/2019

Appendix C - Addendum to the Science Review in Support of the Addition of Chitosan (Poly-DGlucosamine) to the List of Minimum Risk Pesticides (MRPs) Contained in 40 CFR 152.25(f), U.S. Environmental Protection Agency (2022)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF CHEMICAL SAFETY
AND POLLUTION PREVENTION

MEMORANDUM

SUBJECT: Addendum to the science review in support of the addition of chitosan (Poly-D-Glucosamine) to the list of minimum risk pesticides (MRPs) contained in 40 CFR 152.25(f)

Active Ingredient Type:	Biochemical
PC Code:	128930
CAS Number:	9012-76-4
Active Ingredient Tolerance Exemption:	40 CFR 180.1072
Docket Number:	EPA-HQ-OPP-2019-0701

FROM: Harold Cooper, PhD, Physical Scientist
Nicholas Thomas, PhD, Biologist
Baylor Steele, PhD, Biologist
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TO: Linda Hollis, Chief
Biochemical Pesticides Branch
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And

Charles Smith, Division Director
Anne Overstreet, Deputy Division Director
Biopesticides and Pollution Prevention Division

This memorandum contains confidential business information that has been removed to a confidential appendix

In October of 2018, Tidal Vision Products, LLC submitted a petition requesting the addition of chitosan (poly-d-glucosamine) to the list of minimum risk pesticides (MRPs) contained in 40 CFR 152.25(f) under the authority of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), section 25(b). Specifically, the request was to add “the substance commonly called chitosan, with a Chemical

Abstracts Service (CAS) # of 9012-76-4" to the list of pesticide active ingredients (AI) on the list of MRPs. In April of 2019, Tidal Vision Products, LLC amended the petition to include a request to add chitosan to the inert ingredients listed in 40 CFR 152.25(f).
To support the petition and its amendment, Tidal Vision Products, LLC submitted a letter outlining the seven criteria that were considered in the addition of chemicals to the MRP list and how chitosan fulfills each of the seven criteria. In 2019, the EPA reviewed this information and produced an assessment of the application of these criteria to chitosan (US EPA, 2019), which was used to support a proposed rule to add chitosan to the active and inert ingredients listed in 40 CFR 152.25(f) and exempted from regulation under FIFRA.

The petition to include chitosan on the list of MRPs specifically requests addition of chitosan with CAS # 9012-76-4 to the list, which is the chitosan polymer produced from deacetylation of chitin, an insoluble chemical commonly referred to "dry" chitosan. This is the form of chitosan that the Agency understood to be the active ingredient in registered pesticide products containing chitosan at the time of their registration. However, in the industries utilizing chitosan, the term "chitosan" refers not only to this form but can also refer to derivatives of chitosan, including soluble salts of chitosan formed through the reaction of "dry" chitosan with various acids[1]. Through further investigation, the Agency believes that some of the registered products containing "dry" chitosan as active ingredients along with solubilizing acids form chitosan salts[2]. Therefore, since chitosan salts may have increased bioavailability resulting in higher toxicity, a thorough review of the safety of chitosan as a pesticide potentially added to the MRP active ingredients list must include not only the "dry" chitosan with CAS # 9012-76-4, but also chitosan salts that may potentially be formed through combination of "dry" chitosan with acids included on the MRP inert list. Other acids could be added to the MRP inert list in the future and would likely need to be assessed in a similar manner. It should be noted that the Agency's characterization of chitosan and its salts herein does not include nanoparticle formulations or non-acid-base derivatives.

This review presents an addendum to the previous review on chitosan to include information on chitosan salts as it relates to each of the seven criteria considered in adding chitosan to the MRP lists.

BACKGROUND

Pesticidal uses of chitosan according to labels of currently registered products include uses to control nematodes and plant diseases, or as a plant growth regulator, on agricultural sites such as food and non-food crops, residential, greenhouse, and nursery crops; in addition, there are non-agricultural use sites like turf, ornamentals, and trees. The EPA has also registered products containing chitosan for antimicrobial uses to control odor causing, spoilage, and discoloration microbes on textiles and surfaces. The percentage of chitosan in end use products ranges from 0.05% to 85%, and chitosan is present at <5% in most products. Agricultural application rates range from 0.11-2.5 lbs active ingredient (AI)/acre (A) for foliar sprays, 0.13-0.90 lbs/A for soil drench, 0.24-2.5 lbs AI/A for chemigation, and 0.11- 0.33 lbs AI/10 gallons or 3-50 g/100 lbs of seed for seed treatments according to instructions on end-use product (EP) labels. It is understood that if chitosan and its salts are added to the list of MRP active and inert ingredients, these uses and application rates could be expanded; however, it is noted that uses for currently registered agricultural products is extensive.

[1] See, for example, https://www.waterboards.ca.gov/water_issues/programs/stormwater/docs/advtreat/naturalsitesolutions.pdf
[2] See, for example, http://chemtexlaboratories.com/bacshield/wp-content/uploads/2011/09/Bac-Shield-MSDS.pdf; https://s3-us-west-1.amazonaws.com/agrian-cg-fs1-production/pdfs/Consensus_MSDS4.pdf; https://fda.report/DailyMed/a71b8b28-1cca-7056-e053-2a95a90aee5f

Information on the chemical properties and formation of "dry" chitosan are described in the previous assessment (US EPA, 2019). To form "wet" chitosan or chitosan salts, the general process involves solubilization of "dry" chitosan with an acid. These salts may form when the deacetylated amine groups in chitosan are protonated upon acidification of the mixture, resulting in the chitosan becoming a polyelectrolyte. This protonation is a common step in chitosan solubilization, and it is the Agency's understanding that this will result in the formation of conjugate acid-base pairs between the chitosan (base) and the acid used for solubilization (e.g., acetate). These chitosan salts could be formed by mixing chitosan with acids and/or other chemicals currently listed as acceptable for use as inert ingredients in minimum risk pesticide products under 40 CFR 180.950(e). These salts include but are not limited to chitosan acetate, chitosan lactate, chitosan ascorbate, chitosan citrate, chitosan sulfate, chitosan sorbate, and chitosan hydrochloride. The EPA has included available data on chitosan salts which are expected to be present in some currently registered end-use products in the assessment below. If additional acids are included on the MRP inert ingredient lists and utilized in end-use products, the resulting salts would need to be similarly assessed. Refer to Appendix A below for a table of the acids currently on the MRP inert list which could potentially be mixed with chitosan to form chitosan salts.

FACTORS CONSIDERED FOR AMENDING 40 CFR 152.25 TO EXEMPT SUBSTANCES FROM REGULATION UNDER FIFRA (61 Federal Register 8876, March 6, 1996)

As discussed in US EPA (2019), the following seven factors described at 61 Federal Register (FR) 8876 (March 6, 1996) are considered when substances are added to the list of substances exempted from FIFRA requirements as pesticides:

1. Whether the pesticidal substance is widely available to the general public
2. If it is a common food or a constituent of a common food
3. If it has a nontoxic mode of action
4. If it is recognized by the US Food and Drug Administration as safe
5. If there is no information showing significant adverse effects
6. If its use pattern will result in significant exposure
7. If it is likely to be persistent in the environment

Additionally, this FR notice clarified that the factors are not meant to be absolute criteria and certain ones may be unsupported for some substances. However, taken as a whole, the EPA has operated under the belief that these factors indicate that substances proposed for this list will not pose a risk that warrants regulation under FIFRA.

APPLICATION OF THE CRITERIA TO CHITOSAN AND CHITOSAN SALTS

1. Widely available to the general public

The availability of chitosan to the general public was covered in the previous review. While that review focused on chitosan, many of the sources cited also covered chitosan derivatives, including chitosan salts (see Bellich et al., 2016; Hamad et al., 2016; NTP, 2017). It is the Agency's understanding that chitosan and its salts are widely available to the general public, and no information has been provided since the previous review that would refute that understanding.

2. Common food or constituent of a common food

The discussion of chitosan as a common food or constituent of a common food was covered in the previous review. Similar to its availability to the general public, that review focused on chitosan; however, one source from that review also described the presence of chitosan derivatives in food packaging (see Sinha et al., 2012).

3. Nontoxic mode of action

The nontoxic mode of action for chitosan has been addressed in the previous review. There are no known adverse effects reported for humans and other non-target organisms following agricultural, biopharmaceutical, biomedical, cosmetic, textile, and food additive applications of products that contain chitosan (US EPA, 2019). The chitosan quaternary salts appear to be non-toxic based on studies identified in the public literature. Like the parent compound chitosan, the chitosan salt derivatives exhibit antibacterial modes of action that include but are not limited to disruption of the bacterial cell membranes and cell wall integrity; moreover, the salt derivatives enhance the antifungal property of chitosan (Britto et. al., 2011).

4. Recognized by the US FDA as safe

The status of chitosan as a generally-recognized-as-safe (GRAS) substance was discussed in the previous review. According to a search of the available FDA databases (accessed 09/30/2021), none of the chitosan salts considered in this document are designated as GRAS.

5. No information showing significant adverse effects (to humans and nontarget organisms)

A. Effects of chitosan and chitosan salts on human health

The safety profile of chitosan was covered in the previous review. In addition, further review of the literature establishes that chitosan toxicity varies based on molecular weight as well as degree of deacetylation. However, there is no consensus within the literature on size classifications with 'high', 'medium', and 'low' molecular weight nomenclature varying and overlapping between different studies while also not matching the classifications of vendors. Chitosan forms can vary from 3-3,600 kilodaltons and 40-100% deacetylation (NTP, 2017). Currently, the Agency does not have enough information to determine how the molecular weight or degree of deacetylation will influence the potential toxicity of chitosan salts that could be formed with acids currently on the inert list or others that may be added in the future. Use of sources of chitosan that are acceptable for food or medicinal use could limit the scope of these uncertainties.

In the open scientific literature, there is limited information on the toxicity of the chitosan salts familiar to the Agency and the chitosan salts that could be formed using the current MRP inert ingredient list. Toxicology data for these chitosan salts in the literature is limited to acute and repeat dose oral studies in rats with chitosan lactate and chitosan acetate. Additionally, intranasal application of chitosan hydrochloride in rats demonstrated no toxicity to the nasal epithelium, and ocular administration in rabbits was non-irritating. This limited data set suggests that these substances are of low toxicity. However, the Agency acknowledges that many salts can potentially be produced, and toxicology data are not available for all of these substances. Nonetheless, a standard method for solubilizing chitosan utilizes acetic acid for which the available data correlate to the chitosan human health toxicology database.

Chitosan and its salts are anticipated to have similar mammalian toxicological profiles. In non-guideline 28-day oral toxicity studies in male and female rats (Lagarto et. al., 2015), no adverse effects were observed at the highest dose tested (No-observed-adverse-effect-level (NOAEL) = 1000 mg/kg/day (chitosan and chitosan lactate); NOAEL = 700 mg/kg/day (chitosan acetate)). In these studies, body weight, clinical chemistry, hematology, organ weights and histopathology parameters were assessed. Ophthalmological and neurological evaluations and clinical examinations were not reported. Clinical chemistry and hematological effects were observed but were not considered adverse by the study authors due to a lack of histopathological correlation. The Agency could not verify the study authors' conclusions because the histopathology data were not reported.

Guideline acute toxicity studies on an unknown salt of chitosan (6.2% dilution of chitosan in a "weak acid") showed low oral (MRID 45886507, Toxicity Category IV), dermal (MRID 45895201, Toxicity Category IV) and inhalation toxicity (MRID 45886508, Toxicity Category IV). The test substance was considered mildly irritating to the eye (MRID 45886510, Toxicity Category III) and slightly irritating to the skin (MRID 45886509, Toxicity Category IV) and was not a skin sensitizer (MRID 45886511). Chitosan, chitosan lactate and chitosan acetate were not lethal at the highest dose tested (2,000 mg/kg) in nonguideline oral toxicity studies (Lagarto et. al., 2015). In another non-guideline study, an aqueous solution of 1% chitosan hydrochloride produced no irritation in the eyes of rabbits (Di Colo et. al., 2004).

In a review of chitosan hydrochloride (July 2021), the European Commission Directorate-General for Health and Food Safety determined that there were no health concerns for its supported uses. Chitosan hydrochloride was not considered to be a substance of concern nor was it considered to have an inherent capacity to cause endocrine disrupting, neurotoxic or immunotoxic effects. It was concluded that the chemical has neither an immediate or delayed harmful effect on human or animal health nor an unacceptable effect on the environment when used in accordance with the supported uses. These uses include applications to a variety of food crops, ornamental plants and seeds in outdoor and indoor settings.

B. Effects of chitosan and chitosan salts on nontarget organisms

1. Non-target Organism Toxicity

There are currently no guideline non-target terrestrial organism toxicity studies for chitosan or chitosan salts available in the EPA database. As part of the petition to add chitosan and chitosan salts to the list of minimum risk pesticides, Tidal Vision submitted data from aquatic toxicity studies with chitosan acetate. Results from these studies are summarized in Table 1 below.

TABLE 1. Nontarget Organism Toxicity Summary for Potassium Carbonate (40 CFR § 158.2060)

Study/Guideline	Results	Toxicity* Category/Description	Reference
Freshwater fish (*Pimephales promelas*) acute toxicity USEPA Office of Water (2002), EPA-821-R-02-012	96-hour LC_{50} = >4 mg/L[1, 3] NOAEC = 4 mg/L	-	Tidal Vision USA, 2019a
Freshwater fish (*Oncorhynchus mykiss*) acute toxicity US EPA Office of Water (2002), EPA-821-R-02-012	96-hour LC_{50} = >4 mg/L[1, 3] NOAEC = 4 mg/L	-	Tidal Vision USA, 2019a

Freshwater fish (*Oncorhynchus mykiss*) acute toxicity US EPA Office of Water (2002), EPA-821-R-02-012	96-hour LC_{50} = 3.54 mg/L[2] NOAEC = 2.5 mg/L	Moderately toxic	Tidal Vision USA, 2019b
Freshwater fish (*Oncorhynchus mykiss*) 7-day toxicity (850.1075) Lazorchak and Smith (2007)	LOAEC (survival and growth) = >4 mg/L[1, 3] NOAEC = 4 mg/L	-	Tidal Vision USA, 2019a
Aquatic invertebrate (*Ceriodaphnia dubia*) acute toxicity US EPA Office of Water (2002), EPA-821-R-02-012	48- hour LC_{50} = 2.62 mg/L[1] NOAEC = 1.0 mg/L	Moderately toxic	Tidal Vision USA, 2019a
Aquatic invertebrate (*Ceriodaphnia dubia*) 7-day toxicity US EPA Office of Water (2002), EPA-821-R-02-013	LOAEC (reproduction) = 0.5 mg/L[1, 4] NOAEC = 0.25 mg/L	-	Tidal Vision USA, 2019a
Aquatic invertebrate (*Ceriodaphnia dubia*) 7-day toxicity US EPA Office of Water (2002), EPA-821-R-02-013	LOAEC (reproduction) = 0.3 mg/L[2, 4] NOAEC = <0.3 mg/L	-	Tidal Vision USA, 2019b

[1]Data derived from study with product (Tidal Clear 1%) containing 1% chitosan acetate. Toxicity values are based on the concentration of chitosan acetate contained in the product.
[2]Data derived from study with product (Tidal Clear 2%) containing 2% chitosan acetate. Toxicity values are based on the concentration of chitosan acetate contained in the product.
[3]Chitosan acetate toxicity cannot be categorized because treatments used did not cause adequate mortalities to calculate an LC_{50} value.
[4]Chitosan acetate toxicity cannot be categorized because the study did not calculate an LC_{50} value.

In the open scientific literature, much of the terrestrial organism data on chitosan salt effects are for plants. Data from plant studies indicate that chitosan salts provide beneficial effects, including resistance to dehydration (Iriti et al., 2009) and disease (Hadwiger, 2020), as well as improved growth (Algam et al., 2020) and fruit yield (Sajid et al., 2020).

The available scientific literature on chitosan effects to non-target aquatic species include data from studies in aquaculture and in toxicology. When used as a dietary supplement, dry chitosan has been demonstrated to enhance immune function in fish (Siwicki et al. 1994) and promote growth in shrimp (Rochana et al., 2020). Contrastingly, chitosan as an acid solubilized form (chitosan acetate) exhibits a high degree of toxicity to fish when the compound is present in water. A study by Bullock et al. (2000), exposed rainbow trout to 0.019, 0.038, 0.075, 0.75 mg/L chitosan acetate for 7 days in a preliminary toxicity test followed by a 14-day trial whereby trout were exposed to 0.019 and 0.038 mg/L chitosan acetate. The seven-day trial resulted in 0%, 7%, 73%, and 80% mortalities at the 0.019, 0.038, 0.075, 0.75 mg/L treatment levels, respectively. There were no mortalities in the water or 1% acetic acid controls. In the 14-day trial, 47% fish died at the 0.038 mg/L exposure concentration while the 0.019 mg/L concentration resulted in no mortalities.

Research on the toxic mechanisms of chitosan acetate indicates that toxicity in rainbow trout is induced by respiratory distress from hypoxia, which is proposed to be caused by damage or obstruction of branchial epithelium in the gill (Valenzuela et al., 2003). Additionally, mucus secretion caused by hypoxia may increase the diffusion distance for oxygen (Valenzuela et al., 2003). A study by Chou et al. 2020 proposes a similar toxicity mechanism (disruption of membrane epithelial cells) for low molecular weight chitosan hydrochloride when exposed to larval zebrafish. Given the proposed mode of chitosan acetate toxicity, the degree to which chitosan chemistry (free chitosan vs. acid solubilized) affects

chitosan toxicity is uncertain. Data demonstrating the beneficial effects of the free form of chitosan are from dietary studies where exposure primarily occurs through the gut as opposed to the gill, where chitosan acetate is proposed to elicit its toxic effects in fish.

In addition to studies with rainbow trout and zebrafish, chitosan salt aquatic toxicity studies are available for several other species. Research by Wang et al. (2016), determined the acute toxicity of chitosan acetate to carp (*Cyprinus carpio*), *Daphnia magna*, oligochaetes (*Limnodrilus hoffmeisteri*), and algae (*Chlorella vulgaris*). In these experiments, a 96-hour LC_{50} in carp and a 48-hour EC_{50} (immobilization) in *Daphnia* were observed at 3.0 mg/L and 2.2 mg/L, respectively. The 72-hour EC_{50} for cell yield inhibition in algae was 3.5 mg/L. In oligochaetes, the immobilization EC_{50} was observed at 6.9 mg/L after 72 hours of exposure. Based on results from experiments with carp and *Daphnia*, chitosan acetate would be classified as moderately toxic.

2. Aquatic Exposure and Risk Characterization

Chitosan acetate is classified as moderately toxic to fish and aquatic invertebrates though some studies suggest a lower level of toxicity (Table 1). Toxicity data used for the assessment were the lowest observed LC_{50} values for fish (3.54 mg/L) and aquatic invertebrates (2.62 mg/L) (Table 1).

The Pesticide in Water Calculator[3] (PWC version 2.001) was used to calculate chitosan acetate estimated exposure concentrations (EECs) for fish in surface waters. Model inputs (Table 2) were based on chitosan acetate physical/chemical properties and information from the label of an EPA registered product with the highest maximum application rate (resulting in 1.8 lbs chitosan acetate/A). Because the product label is for terrestrial spray applications to a broad range of agricultural crops, risk was determined for the crop scenario (cotton) which resulted in the highest EEC. Environmental exposure was calculated for the maximum application rate at three different application frequencies (1, 6, and 12 applications), each with 1-day application intervals, per season or growing period. These applications are not an assumed maximum seasonal rate because the maximum number of applications and maximum yearly/seasonal rate are not provided on the label. Applications of the total amount of chitosan applied are also based on calculated levels of the salt form (chitosan acetate) contained in the product. Refer to **Appendix B** for the assumptions and calculations used to derive the concentration of chitosan acetate for a theoretical pesticide product. Information specific to any products used in the analysis has been removed to a **Confidential Appendix**. Environmental fate values for chitosan acetate were calculated using EPA's Estimation Programs Suite (EPISuite Version 4.11). The specific models used within the EPISuite program were KOCWIN version 2 (absorption coefficient estimate) and the Level III Fugacity Model (water half-life estimate). Because a simplified molecular-input line-entry system (SMILES) is currently available for chitosan but not chitosan acetate, environmental fate parameters were estimated for chitosan acetate using the chitosan SMILES as a surrogate. The chitosan acetate soil half-life was derived from a study in the scientific literature (Sawaguchi et. al., 2015), which was used in the previous chitosan assessment (US EPA, 2019) associated with this addendum. Refer to **Appendix C** for additional model details, including input parameters and estimated outputs.

Table 2. Summary of Model Inputs for PWC Estimates

Input	Value
Maximum Application rate (kg/ha)	2.02*
Cropped Area Fraction	1

3 https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment#PWC

Table 2. Summary of Model Inputs for PWC Estimates	
Input	**Value**
Koc (ml/g)	1E+010 (EPISuite 4.11)**
Water Half-Life (days) @ 25 °C	15 (EPISuite 4.11)
Benthic Half-Life	Not available
Photolysis Half-Life	Not available
Hydrolysis Half-Life	Not available
Soil Half-Life (days) @ 25 °C	10 (Sawaguchi et. al., 2015)
Foliar Half-Life	Not available
Molecular Weight (g/mole)	1526.48 (PubChem)
Vapor Pressure (torr)	Not available
Solubility (mg/l)	Not available
Henry's Constant	Not available

*Estimated chitosan acetate concentration in formulated product is based on percent deacetylated amine groups and amine group protonation at pH 6.0. Refer to Appendix B for calculation details.
**Estimated Koc value from EPISuite/KOCWIN estimation program is based on the molecular connectivity index (MCI) method.

Results of the exposure modeling and toxicity effects data were used to evaluate the likelihood of adverse ecological effects to aquatic species. To calculate risk quotients (RQs), the 1-day EEC that resulted from either 1, 6, or 12 chitosan acetate applications was divided by the lowest acute toxicity value for fish and invertebrates, resulting in a conservative estimate of risk. The RQs were compared to the Agency's limit of concern (LOC), which is 0.5 and 0.05 for non-listed and listed aquatic species, respectively ("listed" refers to federally listed threatened and endangered species). The RQs calculated using PWC for run-off and spray drift exposure to nontarget listed and non-listed aquatic organisms from use of chitosan acetate are provided in Table 2 below.

Table 3. Acute RQs for fish and aquatic invertebrates exposed to the residues of chitosan aetate.					
Number of Applications*	**Listed Status**	**EEC (mg/L)**	**LC_{50} Value (mg/L)****	**RQ**	**LOC**
Fish**					
1	Non-listed	5.80E-07	3.54	<0.01	0.5
	Listed	5.80E-07	3.54	<0.01	0.05
6	Non-listed	7.85E-07	3.54	<0.01	0.5
	Listed	7.85E-07	3.54	<0.01	0.05
12	Non-listed	9.67E-07	3.54	<0.01	0.5
	Listed	9.67E-07	3.54	<0.01	0.05
Aquatic Invertebrates**					
1	Non-listed	5.80E-07	2.62	<0.01	0.5
	Listed	5.80E-07	2.62	<0.01	0.05
6	Non-listed	7.85E-07	2.62	<0.01	0.5
	Listed	7.85E-07	2.62	<0.01	0.05
12	Non-listed	9.67E-07	2.62	<0.01	0.5
	Listed	9.67E-07	2.62	<0.01	0.05

**Application rate ate is based on highest application (1.8 lb AI/A or 2.02 kg AI/ha) specified by label (ARMOUR-Zen, EPA File Symbol: 75747-3).
**Fish LC_{50} value derived from study with pesticide formulation (Tidal Clear 2%) containing 2% chitosan acetate. Invertebrate LC_{50} value derived from study with pesticide formulation (Tidal Clear 1%) containing 1% chitosan acetate

The RQs are below the LOC for non-listed and listed species at the modeled maximum chitosan acetate application rate across each of the application frequencies. Even though chitosan acetate is moderately

toxic to fish and aquatic invertebrates, the modeled exposure based on repeated uses is low due to high estimated soil partitioning (Koc) and environmental degradation. Therefore, adverse effects to aquatic organisms are not anticipated.

3. Uncertainties

There are several uncertainties in the assumptions used to calculate risk. The study by Bullock et al. (2000), discussed in section B.1 above, was not used as part of the quantitative risk analysis because it did not address specific data requirements, such as reporting of an LC_{50} value, typically required for BPPD environmental risk assessments. However, it is uncertain as to why mortalities in the Bullock et al. study occurred at lower concentrations than the studies submitted to the Agency by Tidal Vision. Given the proposed mechanism (respiratory distress from hypoxia caused by damage or obstruction of branchial epithelium) by which chitosan acetate elicits toxicity in fish, chitosan acetate toxicity may be influenced by organism age because older fish have larger, more developed gills than juvenile fish. The study by Bullock et al. 2000 used adult fish with a mean weight of 120.5 grams as opposed to juvenile fish weighing (<) 3.0 grams as indicated in the EPA toxicity testing guideline (OCSPP 850.1075). Additionally, toxicity data used in this assessment were from static renewal tests that took place over a 96-hr period with test solution renewal at 48 hours. Studies by Bullock et al., on the other hand, used a flowthrough test system whereby solutions were continually renewed over a 7-day period. Water quality parameters, such as dissolved oxygen, were not reported in the studies by Bullock et al., so it cannot be determined whether water quality or other aspects of the conduct of these studies had an impact on the observed toxicity differences between the toxicity studies used in this assessment and those performed by Bullock et al.

The EECs used in this assessment are based on a registered label use rate. The label does not specify the maximum number of yearly or seasonal applications. The current assessment does not account for risks associated with additional applications, higher application rates, or direct applications to water.

Due to the limited environmental fate data available for chitosan and chitosan salts, environmental fate parameters, including Koc and water half-life, used to calculate chitosan acetate EECs are based on computational estimates. Chitosan Koc estimates from the KOCWIN model provides a high Koc value. If measured Koc values for chitosan acetate are lower than modeled values used in the current assessment, then exposure and ultimately risk could be underestimated. However, one of chitosan's current uses is as a flocculent, and it has been shown to reduce erosion-induced soil loss (Orts et al. 2000), so chitosan acetate is not anticipated to enter aquatic habitats at significant levels after application. Lastly, the similarity between chitosan acetate and other salt forms constitutes an uncertainty when assessing risk to aquatic organisms.

6. Use pattern results in significant exposure

Exposure to chitosan was discussed in the prior assessment. In consideration of the salts that could be formed using the current MRP list, it is unlikely that the additional agricultural uses that may be allowed will significantly expand the potential for exposure of humans to chitosan, since current pesticidal uses are already extensive. As stated previously, the Agency believes that some of the registered pesticide products contain chitosan salts or "wet" chitosan, rather than "dry" chitosan, and pesticidal uses of chitosan likely do not contribute more exposure than other uses of chitosan. However, it should be noted that there is a lack of information in the scientific literature identifying if absorption, metabolism and elimination of chitosan salts are equivalent to those of chitosan.

Approved non-pesticidal uses of chitosan salts include biomedical applications such as enhanced wound healing products (e.g., bandages and creams) and cartilage repairing formulations (Straccia, 2015; Rizwan, 2019; Bellich, 2016). The salts are also used in water treatment as flocculation and coagulation agents.

According to the available scientific literature, chitosan salts are also being evaluated in a variety of fields, including pharmacology, biomedicine and polymer science (Bellich, 2016). It is unknown to the Agency if these applications are currently in use or have been approved by any regulatory entities.

7. Not likely to persist in the environment

The persistence of chitosan in the environment was covered in the previous review. Information from the previous review indicate that chitosan may readily degrade in soils. In a study using sandy and silty soils (Sawaguchi et. al., 2015), it was observed that chitosan added to silty soil dissipated by 50% after 10 days incubation at 25°C and was non-detectable after 30 days. As of now, there are no data or information on the persistence of chitosan in aquatic environments however its use as a flocculent suggests persistence in aquatic environments will be low.

CONCLUSIONS

As part of the consideration for the addition of chitosan to the MRP list, the Agency recognizes the necessity to review and include chitosan salts as these can be created during formulation of some chitosan pesticide products. As such, available Agency data were reviewed, and an extensive literature search and data analysis was performed for several chitosan salts. Data and information were the most abundant for chitosan acetate. As such, the data for chitosan acetate was used as a surrogate for evaluating chitosan salts as a group.

The human health assessment database is limited both in terms of studies performed and representative chitosan salts tested. There are also uncertainties in the potential toxicological effects of differences in chitosan molecular weights and degrees of deacetylation which could be mitigated by use of sources of chitosan that are acceptable for food or medicinal use. However, the Agency's overall analysis of the available data suggests that these substances are of low toxicity. No risks of concern have been identified.

There is no evidence that chitosan salts would have any adverse effects on non-target terrestrial organisms. While the use of dry chitosan in fish feed suggests low risk to aquatic taxa, studies identified in the scientific literature indicate chitosan acetate is highly toxic to rainbow trout. Guideline studies available in the Agency's database, on the other hand, indicate that chitosan acetate is moderately toxic to fish and aquatic invertebrates. Studies used in this assessment were selected because they reported the necessary information (e.g., LC_{50} values) for risk calculations and adhered to Agency guidelines. Calculated risks (RQs) based on non-target organism toxicity data and aquatic exposure modeling are below the Agency's limit of concern by several orders of magnitude.

As discussed in more detail above, there are several uncertainties in the exposure and toxicity assumptions used to calculate risk. Of important consideration, is that the Koc value used in the exposure modeling is based on a computational estimate because measured values are currently

unavailable. The chitosan Koc estimate from the KOCWIN model indicates a high tendency for chitosan to bind to soil, and thus a reduced tendency to enter the water column after application to crops. If measured Koc values for chitosan acetate are lower than modeled values used in the current assessment, than exposure and ultimately risk (RQs) are being underestimated. However, chitosan acetate is not anticipated to enter aquatic habitats at significant levels following application to crops because chitosan has been shown to reduce erosion-induced soil loss, which indicates that chitosan acetate will likely have a greater tendency to remain in soil rather than enter the water column following application. Risks to nontarget listed and unlisted organisms are acceptable when chitosan acetate is used in accordance with currently EPA-registered label directions. However, this assessment does not cover all potential future use scenarios for chitosan acetate as an MRP ingredient.

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Appendix A

Acids currently on the MRP Inert List that could be formulated into chitosan salts

Acids		
Acetate	Dicaprylate	Myristate
Acetyl tributyl citrate	Dimyristate	Octanoate
Alginate	Dioleate	Oleate
Benzoate	Distearate	Palmitate
Bicarbonate	Dodecanoate	Ricinoleate
Butanedioate	Fumarate	Silicate
Carbonate	Humate	Sorbate
Citrate	Lactate	Stearate
Decanoate	Malate	Sulfate

Appendix B

Chitosan Salt Concentration Estimate

Relevant parameters for estimating chitosan salt concentrations in a theoretical pesticide formulation are listed below. Information specific to any products used in the analysis has been removed to a **Confidential Appendix**.

- Chitosan concentration
- Acetic acid concentration
- pH of concentrated chitosan before neutralization
- Final pH
- pKa of chitosan's primary amine is 6.5
- Since we are attempting to estimate the highest salt amount, we will assume 95% deacetylation in our calculations
- Percentage of deacetylated amine groups that will be protonated at the formulation's pH
- Pesticidal use rates in lbs active ingredient/acre
- We will assume that acetic acid exists in excess of chitosan and as such, acetate will not be a limiting reagent in the reaction
- Chitosan's protonated amine groups will function as a basic cationic polyelectrolyte (Chawla *et al.* 2014; Pardo-Castaño *et al.* 2019) which will form acid-base conjugate pairs with the anion of the acid, resulting in chitosan salts. We will assume that 100% of the deacetylated, protonated amine groups will form salt

Henderson-Hasselbalch equation with work-up

$$pH = pK_a + \log_{10}\left(\frac{[A-]}{[HA]}\right)$$

$$x = 6.5 + \log_{10}\left(\frac{[A-]}{[HA]}\right)$$

$$(10^{x - 6.5})*[HA] = [A-]$$

Rest of computations

$$[HA] + [A-] = 1$$

$$[A-] = 1 - [HA]$$

$$(10^{x - 6.5})*[HA] = 1 - [HA]$$

$$(10^{x - 6.5})*[HA] + [HA] = 1$$

Solve for $[HA]$

$[HA] = Y$

Y * 100 = Y% deacetylated, protonated amine groups

Assumption of 95% chitosan deacetylation

Assumption that 100% of deacetylated, protonated amine groups will form the salt

0.95 * 1.00 * Y% = Z% of the chitosan salt in the formulation

Z% * application rate (lbs chitosan/acre) = **lbs chitosan-salt per acre.**

Additional considerations

- Chitosan is a polymer with repeating subunits. Each of those subunits has an amine group that can be deacetylated, protonated, and undergo an acid-base reaction to form the salt.
- If the formation of a salt on a single subunit of the polymer were to then increase the affinity of other subunit amines for the salt on that same polymer through an increase in the K_a (association constant), it is conceivable that multiple acetate ions would associate with the same chitosan polymer. This would leave an insufficient amount of acetate to form the salt with all of the protonated amines and make our calculations incorrect.
    - There is no available information suggesting a changing association constant with salt interaction
    - Even if this were to occur, it would decrease overall salt-form concentration and as such, our current estimate would account for the upper limit of chitosan salt application

Appendix C

Water Modeling of Chitosan Acetate Applied to Cotton and the USEPA Standard Pond

Estimated Environmental Concentrations for chitosan acetate are presented in Table 1 below for the USEPA standard pond with the NCcottonSTD field scenario. A graphical presentation of the year-to-year acute values is presented in Figure 1. These values were generated with the Pesticide Water Calculator (PWC), Version 2.001. Critical input values for the model are summarized in Tables 2 and 3 below.

This model estimates that about 2.1% of chitosan acetate applied to the field eventually reaches the water body. The main mechanism of transport from the field to the water body is by spray drift (60.2% of the total transport) followed by erosion (39.9%).

In the water body, chitosan acetate dissipates with an effective water column half-life of 26.6 days. (This value does not include dissipation by transport to the benthic region; it includes only processes that result in removal of chitosan acetate from the complete system.) The main source of dissipation in the water column is metabolism (effective average half-life = 26.6 days).

In the benthic region, chitosan acetate is stable. The vast majority of chitosan acetate in the benthic region (100%) is sorbed to sediment rather than in the pore water.

Table 1. Estimated Environmental Concentrations (ppb) for chitosan acetate.

1-day Avg (1-in-10 yr)	0.9672E-003
4-day Avg (1-in-10 yr)	0.4741E-003
21-day Avg (1-in-10 yr)	0.4456E-003
60-day Avg (1-in-10 yr)	0.4297E-003
365-day Avg (1-in-10 yr)	0.4120E-003
Entire Simulation Mean	0.2371E-003

Table 2. Summary of Model Inputs for chitosan acetate.

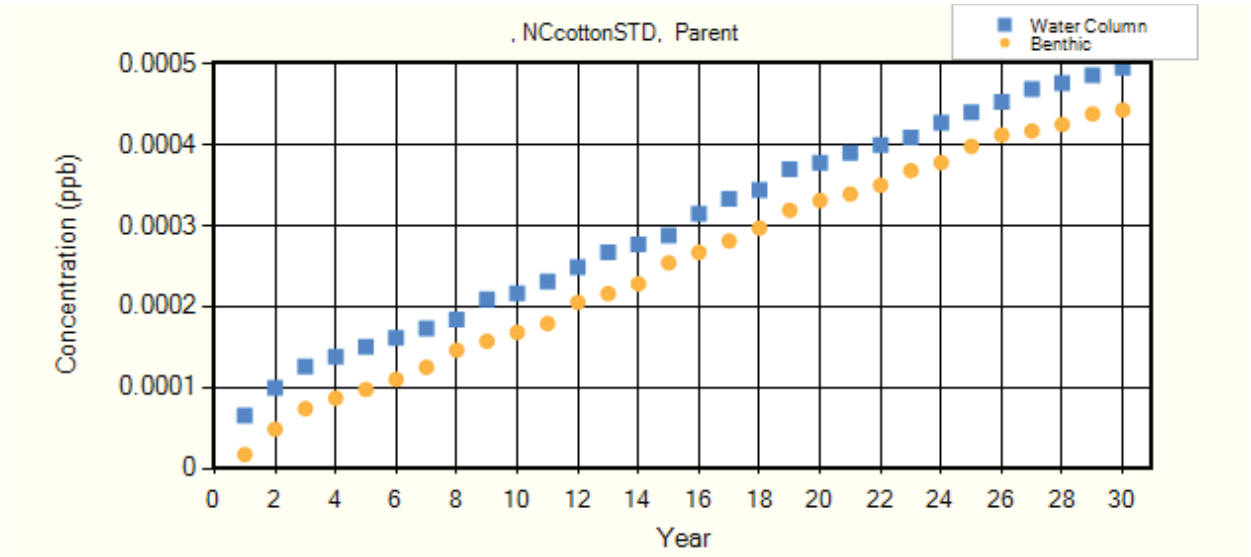
Scenario	NCcottonSTD
Cropped Area Fraction	1
Koc (ml/g)	1E+010 (EPISuite 4.11)
Water Half-Life (days) @ 25 °C	15 (EPISuite 4.11)
Benthic Half-Life (days) @ °C	
Photolysis Half-Life (days) @ °Lat	
Hydrolysis Half-Life (days)	
Soil Half-Life (days) @ °C	10 (Sawaguchi et. al., 2015)

Foliar Half-Life (days)	
Molecular Weight	1526.48 (PubChem)
Vapor Pressure (torr)	
Solubility (mg/l)	
Henry's Constant	

Table 3. Application Schedule for chitosan acetate.

Date (Days Since Emergence)	Type	Amount (kg/ha)	Eff.	Drift
0	Above Crop (Foliar)	2.02	0.95	0.125
1	Above Crop (Foliar)	2.02	0.95	0.125
2	Above Crop (Foliar)	2.02	0.95	0.125
3	Above Crop (Foliar)	2.02	0.95	0.125
4	Above Crop (Foliar)	2.02	0.95	0.125
5	Above Crop (Foliar)	2.02	0.95	0.125
6	Above Crop (Foliar)	2.02	0.95	0.125
7	Above Crop (Foliar)	2.02	0.95	0.125
8	Above Crop (Foliar)	2.02	0.95	0.125
9	Above Crop (Foliar)	2.02	0.95	0.125
10	Above Crop (Foliar)	2.02	0.95	0.125
11	Above Crop (Foliar)	2.02	0.95	0.125

Figure 1. Yearly Highest 1-day Average Concentrations


, NCcottonSTD, Parent
Water Column
Benthic
Concentration (ppb)
0.0005
0.0004
0.0003
0.0002
0.0001
0
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
Year

Appendix D - SDS for Chitosan Flake

SAFETY DATA SHEET

This safety data sheet was created pursuant to the requirements of:
US - OSHA Hazard Communication Standard (29 CFR 1910.1200)

Issuing Date 15- Apr-2021 **Revision Date** 16-Jun-2023 **Revision Number** 3

1. Identification

Product identifier

Product Name Chitosan

Other means of identification

Product Code(s) CAS#: 9012-76-4

Synonyms HMW Chitosan, LMW Chitosan, ULMW Chitosan

Recommended use of the chemical and restrictions on use

Recommended use Laboratory chemicals, chemical manufacturing, agriculture, water treatment, textiles.

Restrictions on use None known

Details of the supplier of the safety data sheet

Supplier Address
Tidal Vision
3710 Iron Gate Rd.
Bellingham, WA 98226
Telephone #: 360-603-7676

E-mail customerservice@tidalvisionusa.com

Emergency telephone number

Emergency telephone Chemtrec 1-800-424-9300

2. Hazard(s) identification

Classification

This chemical is not considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200).

Hazards not otherwise classified (HNOC)
Not applicable.

Label elements

Hazard statements
Not classified.

Other information
No information available.

3. Composition/information on ingredients

Substance

Not applicable.

Mixture

Chemical name	CAS No	Weight-%	Trade secret
Chitosan	9012-76-4	100	

*The exact percentage (concentration) of composition has been withheld as a trade secret.

4. First-aid measures

Description of first aid measures

General advice Show this safety data sheet to the doctor in attendance.

Inhalation Remove to fresh air.

Eye contact Rinse thoroughly with plenty of water for at least 15 minutes, lifting lower and upper eyelids. Consult a physician.

Skin contact Wash skin with soap and water.

Ingestion Clean mouth with water and afterwards drink plenty of water.

Self-protection of the first aider Ensure that medical personnel are aware of the material(s) involved, take precautions to protect themselves and prevent spread of contamination. Avoid contact with eyes. Wear personal protective clothing (see section 8).

Most important symptoms and effects, both acute and delayed

Symptoms None known.

Effects of Exposure No information available.

Indication of any immediate medical attention and special treatment needed

Note to physicians Treat symptomatically.

5. Fire-fighting measures

Suitable Extinguishing Media Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

Unsuitable extinguishing media Do not scatter spilled material with high pressure water streams.

Specific hazards arising from the Thermal decomposition can lead to release of irritating gases and vapors.

chemical

Hazardous combustion products Carbon oxides.

Explosion data
Sensitivity to mechanical impact None.
Sensitivity to static discharge None.

Special protective equipment and precautions for fire-fighters Firefighters should wear self-contained breathing apparatus and full firefighting turnout gear. Use personal protection equipment.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures

Personal precautions Use personal protective equipment as required. Avoid contact with eyes.

Methods and material for containment and cleaning up

Methods for containment Prevent further spillage if safe to do so.

Methods for cleaning up Sweep up into appropriate storage vessel and dispose of in accordance with local regulations.

7. Handling and storage

Precautions for safe handling

Advice on safe handling Handle in accordance with good industrial hygiene and safety practice. Use personal protective equipment as required. Wash hands thoroughly after handling.

Conditions for safe storage, including any incompatibilities

Storage Conditions Keep containers tightly closed in a dry, cool and well-ventilated place.

8. Exposure controls/personal protection

Control parameters

Exposure Limits None for this product.

Appropriate engineering controls

Engineering controls Showers
Eyewash stations
Ventilation systems.

Individual protection measures, such as personal protective equipment

Eye/face protection If splashes are likely to occur, wear safety glasses with side-shields.

Hand protection No protective equipment is needed under normal use conditions.

Skin and body protection No protective equipment is needed under normal use conditions.

Respiratory protection	If large amounts of dust will be suspended in the air wear appropriate respiratory protection such as an N95 mask.
General hygiene considerations	Handle in accordance with good industrial hygiene and safety practice. Avoid contact with eyes.

9. Physical and chemical properties

Information on basic physical and chemical properties

Appearance	Fine powder or flakes
Physical state	Solid
Color	White/ beige to light brown
Odor	Characteristic
Odor threshold	No data available

Property	**Values**	**Remarks • Method**
pH		No data available
pH (as aqueous solution)		No data available
Melting point / freezing point		No data available
Initial boiling point and boiling range		No data available
Flash point		No data available
Evaporation rate		No data available
Flammability		No data available
Flammability Limit in Air		
Upper flammability or explosive limits		No data available
Lower flammability or explosive limits		No data available
Vapor pressure		No data available
Vapor density		No data available
Relative density		No data available
Water solubility		No data available
Solubility(ies)		No data available
Partition coefficient		No data available
Autoignition temperature		No data available
Decomposition temperature		No data available
Kinematic viscosity		No data available
Dynamic viscosity		No data available

Other information

Explosive properties	No information available
Oxidizing properties	No information available
Softening point	No information available
Molecular weight	No information available
VOC content	No information available
Liquid Density	No information available
Bulk density	No information available

10. Stability and reactivity

Reactivity	None under normal use conditions.
Chemical stability	Stable under normal conditions.
Possibility of hazardous reactions	None under normal processing.

Conditions to avoid None known based on information supplied.

Incompatible materials None known based on information supplied.

Hazardous decomposition products Carbon oxides.

11. Toxicological information

Information on likely routes of exposure

Product Information

Inhalation No known effects under normal use conditions.

Eye contact No known effects under normal use conditions.

Skin contact No known effects under normal use conditions.

Ingestion No known effect based on information supplied.

Symptoms related to the physical, chemical and toxicological characteristics

Symptoms None known.

Acute toxicity .

Numerical measures of toxicity
No information available

Component Information

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Skin corrosion/irritation No information available.

Serious eye damage/eye irritation No information available.

Respiratory or skin sensitization No information available.

Germ cell mutagenicity No information available.

Carcinogenicity No information available.

Reproductive toxicity No information available.

STOT - single exposure No information available.

STOT - repeated exposure No information available.

Aspiration hazard No information available.

Other adverse effects No information available.

Interactive effects No information available.

12. Ecological information

Ecotoxicity The environmental impact of this product has not been fully investigated.

Persistence and degradability No information available.

Bioaccumulation There is no data for this product.

Component Information

Other adverse effects No information available.

13. Disposal considerations

Waste treatment methods

Waste from residues/unused products Dispose of in accordance with local regulations. Dispose of waste in accordance with environmental legislation.

Contaminated packaging Do not reuse empty containers.

California Hazardous Waste Status This product contains one or more substances that are listed with the State of California as a hazardous waste.

14. Transport information

DOT Not regulated

IATA Not regulated

IMDG Not regulated

15. Regulatory information

International Inventories

Contact supplier for inventory compliance status

US Federal Regulations

SARA 313

Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product does not contain any chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372.

SARA 311/312 Hazard Categories

Should this product meet EPCRA 311/312 Tier reporting criteria at 40 CFR 370, refer to Section 2 of this SDS for appropriate classifications.

CWA (Clean Water Act)

This product contains the following substances which are regulated pollutants pursuant to the Clean Water Act (40 CFR 122.21 and 40 CFR 122.42).

CERCLA
This material, as supplied, contains one or more substances regulated as a hazardous substance under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302).

US State Regulations

California Proposition 65
This product does not contain any Proposition 65 chemicals.

U.S. State Right-to-Know Regulations

U.S. EPA Label Information

EPA Pesticide Registration Number Not applicable

16. Other information

NFPA	**Health hazards** 1	**Flammability** 0	**Instability** 0	**Special hazards** -
HMIS	**Health hazards** 1	**Flammability** 0	**Physical hazards** 0	**Personal protection** X

Key or legend to abbreviations and acronyms used in the safety data sheet

Legend Section 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

TWA	TWA (time-weighted average)	STEL	STEL (Short Term Exposure Limit)
Ceiling	Maximum limit value	*	Skin designation

Key literature references and sources for data used to compile the SDS
Agency for Toxic Substances and Disease Registry (ATSDR)
U.S. Environmental Protection Agency ChemView Database
European Food Safety Authority (EFSA)
EPA (Environmental Protection Agency)
Acute Exposure Guideline Level(s) (AEGL(s))
U.S. Environmental Protection Agency Federal Insecticide, Fungicide, and Rodenticide Act
U.S. Environmental Protection Agency High Production Volume Chemicals
Food Research Journal
Hazardous Substance Database
International Uniform Chemical Information Database (IUCLID)
Japan GHS Classification
Australia National Industrial Chemicals Notification and Assessment Scheme (NICNAS)
NIOSH (National Institute for Occupational Safety and Health)
National Library of Medicine's ChemID Plus (NLM CIP)
National Library of Medicine’s PubMed database (NLM PUBMED)
National Toxicology Program (NTP)
New Zealand's Chemical Classification and Information Database (CCID)
Organization for Economic Co-operation and Development Environment, Health, and Safety Publications
Organization for Economic Co-operation and Development High Production Volume Chemicals Program
Organization for Economic Co-operation and Development Screening Information Data Set
World Health Organization

Issuing Date 15-Apr-2021

Revision Date 16-Jun-2023

Revision Note Updated to new SDS format

Disclaimer

The information provided in this Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

End of Safety Data Sheet

Appendix E- SDS for GENMAX, End Use Chitosan Product

SAFETY DATA SHEET

Tidal Grow® GENMAX

1. IDENTIFICATION

Product Name: Tidal Grow®GENMAX

EPA Reg. No. 93966-1

Recommended Use: Seed Treatment; See product label for a complete list of uses and use sites.

Restrictions on Use: See product label for any restrictions on the use of this product.

Chemical Name: Chitosan

Distributed by: Tidal Vision Products, Inc.
3710 Iron Gate Rd
Bellingham, WA 98226

For Medical Exposure Concerns, Contact the Poison Control Center: 1-800-222-1222

2. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW: Light yellow to brown liquid with slight odor

OSHA HCS CLASSIFICATION (29 CFR 1910.1200)

Acute Inhalation Toxicity	Category 4
Eye Damage/Irritation	Category 2B

Signal Word: WARNING

Hazard Statement(s): Harmful if inhaled.
Causes eye irritation.

Precautionary Statement(s): **Prevention:** Avoid breathing mist/vapors/spray. Use only outdoors or in a well-ventilated area. Wash hands thoroughly after handling.
Response: If inhaled: Remove person to fresh air and keep comfortable for breathing. Call a poison control center or doctor for treatment advice if you feel unwell.
If in eyes: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. If eye irritation persists: seek medical attention.
Storage: No statements required.
Disposal: No statements required.

The following percentage of the mixture consists of components with unknown hazards regarding the acute toxicity: 0%

3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Name	CAS Number	Weight %
Chitosan	9012-76-4	0.25%

*Ingredients not listed or listed with a weight % range are considered a trade secret and are withheld under 29 CFR 1910.1200(i).

4. FIRST AID MEASURES

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 poison control center or doctor for treatment advice
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 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
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 a poison control center or doctor. Do not give anything to an unconscious person
Most important symptoms/effects, acute and delayed: Eye irritation including redness, itching and tearing.	

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media	Water fog, foam, dry chemical, carbon dioxide (CO2), water spray
Unsuitable extinguishing media	None known
Hazardous Combustion Products:	Thermal decomposition may include toxic and irritating gases.
Special Protective Equipment & Precautions:	Wear NIOSH/MSHA approved self-contained breathing apparatus and full bunker gear. Dike area to prevent runoff and contamination of water sources. Dispose of fire control water later. Avoid breathing vapors; keep upwind.
Unusual Fire & Explosion Hazards:	None known

SECTION 6: ACCIDENTAL RELEASE MEASURES

Personal Precautions:	See Section 8 for personal protection equipment.
Environmental Precautions:	Do not allow spilled product to enter sewers or waterways.
Methods for Containment:	Contain spilled product by diking area with sand or earth.
Methods for Clean-up:	Cover contained spill with an inert absorbent material such as sand, vermiculite or other appropriate material. Vacuum, scoop or sweep up material and place in a container for disposal. Do not place spilled material back in original container.
Other Information:	None known

SECTION 7: HANDLING AND STORAGE

Handling: RECOMMENDATIONS ARE INTENDED FOR MANUFACTURING, PACKAGING AND COMMERCIAL BLENDING WORKERS. PESTICIDE APPLICATORS AND HANDLERS must refer to the product label and Directions for Use attached to the product for Agricultural Use Requirements in accordance with the EPA Worker Protection Standard 40 CFR part 170. Ensure adequate ventilation during handling and use. Immediately clean up spills that occur during handling. Keep containers closed when not in use. Practice good hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Storage: Store in a secured area away from children, feed and food products. Store in original container only and in a cool, well-ventilated dry place above the minimum storage temperature.

Storage Temperature (Min/Max): Protect from freezing

Product Incompatibilities: Strong bases, strong oxidizing agents and strong reducing agents

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

Exposure Guidelines:

COMPONENT	OSHA PEL	ACGIH TLV	NIOSH REL
Nuisance particulate (liquefied mist)		10 mg/m3 TWA	

Engineering Controls: Provide general or local exhaust ventilation systems to maintain airborne concentrations below OSHA PELs or other specified exposure limits. Local exhaust ventilation is preferred.

Respiratory Protection: For most well-ventilated conditions, no respiratory protection should be needed. If airborne concentrations exceed permissible levels or if a pre-existing respiratory condition exists, use a NIOSH approved air-purifying respirator with cartridges/canisters approved for general particulates.

Eye Protection: Wear chemical goggles or safety glasses and full face shield. Contact lenses are not protective eye devices.

Protective Gloves: Wear chemically protective gloves.

Other Protective Clothing: Wear long-sleeve shirt, long pants and shoes plus socks to prevent skin contact.

General Safety Measures: Never eat, drink, nor use tobacco in work areas. Practice good hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

Appearance: Clear to light brown liquid

Odor: Slight
Odor Threshold: Not determined
pH: 4—5
Melting /Freezing Point: Not determined

Boiling Point/Range: >212° F (>100° C)
Flash Point: Not combustible
Evaporation Rate: Not determined
Flammability: Not applicable

Upper/Lower Flammability Limits: Not determined

Vapor Pressure: Not determined
Vapor Density: Not determined
Relative Density: 1.015 – 1.03 g/cm3
Solubility (water): Soluble in water lightly acid

Partition Coefficient: Not determined
Auto-ignition Temperature: Not determined
Decomposition Temperature: Not determined
Viscosity: Not determined

SECTION 10: STABILITY AND REACTIVITY

Reactivity: None known

Chemical Stability: Stable under normal storage and handling conditions.

Possibility of Hazardous Reactions: Will not occur

Conditions to Avoid: Excessive heat

Incompatible Materials: None expected

Hazardous Decomposition Products: Thermal decomposition may include toxic and irritating gases.

SECTION 11: TOXICOLOGICAL INFORMATION

Likely Routes of Exposure: Eye contact, Skin contact, Inhalation, Ingestion
Symptoms of Exposure: Eye irritation including redness, itching and tearing.
Oral LD50: >5000 mg/kg (rat)
Dermal LD50: >5000 mg/kg (rabbit)
Inhalation LC50: >2.0 mg/L (rat)
Eye Irritation/Damage: Moderate irritant
Skin Corrosion/Irritation: Slightly irritating
Skin Sensitization: Does not elicit as skin sensitization reaction (guinea pig).

Chronic/Sub-chronic Toxicity: No data available
Mutagenicity: No data available
Reproductive Toxicity: No data available
Neurotoxicity: No data available
Target Organs: No data available
Aspiration Hazard: None

Carcinogenicity:

Chemical Name	ACGIH	IARC	NTP	OSHA
None listed				

SECTION 12: ECOLOGICAL INFORMATION

ECOTOXICITY DATA:

Fish Toxicity: No data available
Aquatic Invertebrate Toxicity: No data available
Aquatic Plant Toxicity: No data available
Avian Toxicity: No data available
Honeybee Toxicity: No data available

ENVIRONMENTAL EFFECTS:

Persistence and Degradability: No data available
Bioaccumulation: No data available
Mobility: No data available
Other Adverse Effects: No data available

SECTION 13: DISPOSAL CONSIDERATIONS

Waste Disposal: Wastes resulting from the use of this product must be disposed of on site or at an approved waste disposal facility.

Container Disposal: Triple rinse and recycle the container or dispose of in accordance with Federal, state and local laws and regulations. See pesticide label for full instructions on container disposal.

RCRA Characteristics: It is the responsibility of the individual disposing of this product to determine the RCRA classification and hazard status of the waste.

SECTION 14: TRANSPORTATION INFORMATION

DOT (Ground): This product is not regulated by the U.S. Department of Transportation as a hazardous material for ground shipment.

IMDG (Sea): UN3082, Environmentally hazardous substance, liquid, N.O.S. (chitosan), 9, PGIII, Marine Pollutant

IATA UN3082, Environmentally hazardous substance, liquid, N.O.S. (chitosan), 9, PGIII, Marine

(Air): Pollutant

SECTION 15: REGULATORY INFORMATION

TSCA Inventory: This product is exempt from TSCA listing requirements as it is solely for FIFRA regulated use.

EPA Labeling Information (FIFRA): This chemical is a pesticide product registered by the Environmental Protection Agency and is subject to certain labeling requirements under federal pesticide law. These requirements differ from the classification criteria and hazard information required for safety data sheets and for workplace labels of non-pesticide chemicals. Following is the hazard information as required on the pesticide label:

CAUTION: Causes moderate eye irritation. Avoid contact with eyes. Wash thoroughly with soap and water after handling.

SARA Title III Information:

Section 302 – Extremely hazardous substances: None listed
Section 311/312 – Hazard Categories: Immediate (Acute)
Section 313 – This product contains a chemical or chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372:

Chemical Name	CAS Number	Weight %	SARA 313 – Threshold Values %
None listed			

CERCLA – This product contains the following chemicals which have a reportable quantity (RQ) under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA):

Chemical Name	CAS Number	RQ	Quantity of Finished Product
None listed			

CALIFORNIA PROPOSITION 65:

Chemical Name	CAS Number	Prop 65 Category(ies)
None listed		

U.S. STATE RIGHT-TO-KNOW REGULATIONS:

Chemical Name	New Jersey	Massachusetts	Pennsylvania
None listed			

SECTION 16: OTHER INFORMATION

NEPA	Health Hazards 1	Flammability 0	Instability 0	Special Hazards – None

Disclaimer: The information contained in this MSDS is by way of general comment only. Because conditions of use, suitability of product, and application conditions are beyond the control of GenMax LLC, this MSDS does not offer any advice in respect to any product. The authors and GenMax LLC hereby disclaim any liability to any person, property, or thing in respect of any consequence of anything done or omitted to be done by any person in reliance, whether wholly or in part, upon whole or part of the contents of this MSDS.

Revision Date: 10-11-2023 (Version 3)
Document Superseded: - Version 2
Revision Note: - Updated name.

Appendix F - NTP Technical Report on the Toxicity of Chitosan

NTP
National Toxicology Program
U.S. Department of Health and Human Services

NTP Technical Report on the Toxicity Study of Chitosan (CASRN 9012-76-4) Administered in Feed to Sprague Dawley [Crl:CD(SD)] Rats

NTP TOX 93

DECEMBER 2017

NTP Technical Report on the Toxicity Study of Chitosan (CASRN 9012-76-4) Administered in Feed to Sprague Dawley [CrlI:CD(SD)] Rats

Toxicity Report 93

December 2017

National Toxicology Program
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Research Triangle Park, North Carolina, USA

Foreword

The National Toxicology Program (NTP) is an interagency program within the Public Health Service (PHS) of the Department of Health and Human Services (HHS) and is headquartered at the National Institute of Environmental Health Sciences of the National Institutes of Health (NIEHS/NIH). Three agencies contribute resources to the program: NIEHS/NIH, the National Institute for Occupational Safety and Health of the Centers for Disease Control and Prevention (NIOSH/CDC), and the National Center for Toxicological Research of the Food and Drug Administration (NCTR/FDA). Established in 1978, NTP is charged with coordinating toxicological testing activities, strengthening the science base in toxicology, developing and validating improved testing methods, and providing information about potentially toxic substances to health regulatory and research agencies, scientific and medical communities, and the public.

The Toxicity Study Report series began in 1991. The studies described in the Toxicity Study Report series are designed and conducted to characterize and evaluate the toxicologic potential of selected substances in laboratory animals (usually two species, rats and mice). Substances selected for NTP toxicity studies are chosen primarily on the basis of human exposure, level of production, and chemical structure. The interpretive conclusions presented in the Toxicity Study Reports are based only on the results of these NTP studies. Extrapolation of these results to other species, including characterization of hazards and risks to humans, requires analyses beyond the intent of these reports. Selection per se is not an indicator of a substance's toxic potential.

NTP conducts its studies in compliance with its laboratory health and safety guidelines and FDA Good Laboratory Practice Regulations and must meet or exceed all applicable federal, state, and local health and safety regulations. Animal care and use are in accordance with the Public Health Service Policy on Humane Care and Use of Animals. Studies are subjected to retrospective quality assurance audits before being presented for public review.

NTP Toxicity Study Reports are indexed in the National Center for Biotechnology Information (NCBI) Bookshelf and are available free of charge electronically on the NTP website (http://ntp.niehs.nih.gov). Toxicity data are available through NTP's Chemical Effects in Biological Systems (CEBS) database: https://www.niehs.nih.gov/research/resources/databases/index.cfm.

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This report has been reformatted to meet new NTP publishing requirements;
its content has not changed.

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Peer Review

The draft *NTP Technical Report on the Toxicity Study of Chitosan (CASRN 9012-76-4) Administered in Feed to Sprague Dawley [Crl:CD(SD)] Rats* was evaluated by the reviewers listed below. These reviewers served as independent scientists, not as representatives of any institution, company, or governmental agency. In this capacity, reviewers determined if the design and conditions of this NTP study were appropriate and ensured that this Toxicity Study Report presents the experimental results and conclusions fully and clearly.

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Abstract

Chitosan is a cationic carbohydrate polymer that is commercially derived from the deacetylation of chitin obtained from seafood shells. The most widespread route of human exposure to chitosan is as a dietary supplement for body weight reduction. Chitosan was nominated by the National Cancer Institute for mechanistic studies designed to measure the potential for vitamin E depletion and osteoporosis following ingestion. Male and female Sprague Dawley rats were exposed to chitosan (86.5% deacetylated, with an average molecular weight of approximately 82 kilodaltons and estimated to be approximately 94% pure) in feed for 6 months.

In this 6-month study, groups of 10 male and 10 female core study rats (Group A) were fed control diets (AIN-93M) or diets containing chitosan at concentrations of 1%, 3%, or 9%, for up to 25 weeks. Two additional groups of 10 male and 10 female rats (Groups B and C) were given the same dietary concentrations for up to 26 weeks. All male and female Group A rats survived to the end of the study. Mean body weights and feed consumption of exposed Group A groups were similar to those of the control groups. Dietary concentrations of 1%, 3%, and 9% resulted in average daily doses of approximately 450, 1,500, and 5,200 mg chitosan/kg body weight per day to males and 650, 1,800, and 6,000 mg/kg per day to females. There were no treatment-related clinical findings in core study animals.

The 9% male and female rats had significantly decreased cholesterol values (26% to 48%), compared to the controls, at all time points. Triglycerides were significantly decreased in 9% male and female rats, but not at every time point. Phosphorus levels were significantly decreased in 9% male rats at weeks 13, 19, and 25; a decrease also occurred in 3% males at week 13. Phosphorus levels were significantly decreased in 3% and 9% females at weeks 13 and 25.

Compared to those of the controls, serum vitamin A concentrations were significantly decreased (approximately 30%) at weeks 13, 19, and 26 in 9% males, at weeks 13 and 26 in 3% males (approximately 15%), and at weeks 19 and 26 in 9% females (approximately 20%). Serum vitamin E concentrations were significantly decreased at all time points in 3% (33% to 42%) and 9% (79% to 82%) males, in 1% (17%) males at week 13, and in 9% (62% to 65%) females at all time points. Hepatic vitamin E concentrations were significantly decreased at week 26 in 3% (48%) and 9% (87%) males and 9% (80%) females. Serum concentrations of 1,25 $(OH)_2$ vitamin D were significantly increased in 9% (105% to 142%) males and (100% to 180%) females at weeks 7, 19, and 26.

Compared to the control groups, percent fat digested was significantly decreased during week 6 in 9% males and females, during week 12 in 3% and 9% males, during week 18 in 9% males and females, and during week 24 in all exposed groups of males and females. Calcium absorption was significantly increased in 9% females during weeks 12 and 24. Fecal weight was significantly increased in 3% and 9% males and females during each collection period, and in 1% females during weeks 12, 18, and 24. Fecal moisture was significantly increased in 9% males (up to 170%) and 9% females at all time points, in 3% males during week 6, and in 3% females during weeks 12 and 18.

Results of this study did not support chitosan as a cause of bone resorption. Significant elevation of parathyroid hormone levels occurred occasionally and inconsistently, while calcium levels remained relatively stable. Bone calcium, bone length, and the histology findings did not indicate calcium loss from the bone following chitosan exposure.

The absolute and relative liver weights of 9% males and females and the absolute and relative thymus weights of 3% males and 9% males and females were significantly less than those of the control groups.

There was a treatment-related decrease in the incidence of periportal fatty change in the liver of 9% females relative to the control group. A decreased incidence of periportal fatty change was observed in the liver of 9% males relative to the control group as well, but this decrease was not significant, and it was the same as that observed in 1% males. The appearance of periportal fatty change was similar in both males and females and in both exposed and control groups.

Under the conditions of the 6-month feed study of chitosan, male and female rats fed 3% and 9% chitosan in the diet had significantly decreased levels of serum vitamin A and serum and hepatic vitamin E and increased levels of serum 1,25 $(OH)_2$ vitamin D. Consumption of high levels of chitosan decreased percentage fat digestion and increased fecal weight and moisture, as well as reduced levels of phosphorous, cholesterol, and triglycerides. Female rats exposed to 9% chitosan also had significant liver weight and histologic changes. Based on the above results, the lowest-observed-effect level for chitosan exposure was 1% (approximately equivalent to 450 mg/kg) in male and 9% (approximately equivalent to 6,000 mg/kg) in female rats.

Synonyms: 2-Amino-2-deoxy-beta-D-glucosamine; deacetylated chitin; poliglusam; poly (D-glucosamine)

Trade names: Celox, Chicol, Chitopearl, CTFA 04299, Flonac N, Kytex H, Sea Cure F

Summary of Findings Considered to be Toxicologically Relevant in Sprague Dawley Rats Exposed to Chitosan in Feed for Six Months

	Male Rats	Female Rats
Concentrations in feed	0%, 1%, 3%, 9%	0%, 1%, 3%, 9%
Survival rates	Group A: 10/10, 10/10, 10/10, 10/10 Group B: 9/10, 10/10, 10/10, 8/10 Group C: 10/10, 10/10, 10/10, 10/10	Group A: 10/10, 10/10, 10/10, 10/10 Group B: 10/10, 10/10, 9/10, 10/10 Group C: 10/10, 9/10, 10/10, 10/10
Body weights	Exposed groups similar to the control group	Exposed groups similar to the control group
Clinical findings	None	None
Clinical pathology	↓ Phosphorus ↓ Cholesterol ↓ Triglycerides	↓ Phosphorus ↓ Cholesterol ↓ Triglycerides
Vitamin concentrations	↓ Serum vitamin A ↑ Serum 1,25 $(OH)_2$ vitamin D ↓ Serum vitamin E ↓ Hepatic vitamin E	↓ Serum vitamin A ↑ Serum 1,25 $(OH)_2$ vitamin D ↓ Serum vitamin E ↓ Hepatic vitamin E
Digestive parameters	↓ Percent fat digested ↑ Fecal weight ↑ Fecal moisture	↓ Percent fat digested ↑ Fecal weight ↑ Fecal moisture ↑ Calcium absorbed
Bone parameters	None	None
Reproductive toxicity	None	Not determined
Organ weights	↓ Absolute and relative liver weights ↓ Absolute and relative thymus weights	↓ Absolute and relative liver weights ↓ Absolute and relative thymus weights
Nonneoplastic effects	None	Liver: periportal, fatty change (7/10, 4/10, 4/10, 0/10)

Introduction

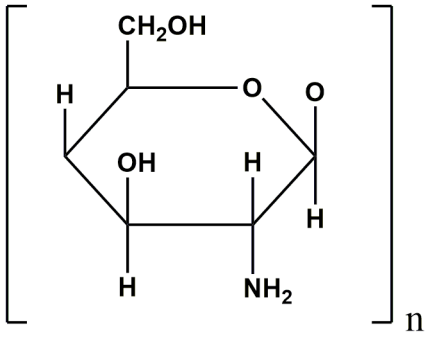

Figure 1. Chitosan (CASRN 9012-76-4; Chemical Formula: $[C_6H_{11}NO_4]_n$)

Synonyms: 2-Amino-2-deoxy-beta-D-glucosamine; deacetylated chitin; poliglusam; poly. (D-glucosamine).
Trade names: Celox, Chicol, Chitopearl, CTFA 04299, Flonac N, Kytex H, Sea Cure F.

Chemical and Physical Properties

Chitosan is a cationic carbohydrate polymer that is commercially derived from the deacetylation of chitin. The primary unit of the chitosan polymer is D-glucosamine. Chitosan exists in multiple forms that can differ in molecular weight [3 to 3,600 kilodaltons (kDa)] and in the degree of deacetylation (40% to 100%)[1]. Chitosan is defined as chitin that is sufficiently deacetylated to form soluble amine salts. Solubility in aqueous, acidic media occurs when deacetylation of chitin reaches approximately 50%[2]. In addition to the degree of deacetylation, chitosan solubility is also dependent on the molecular weight and the distribution of the remaining acetyl groups on the polymer[3]. Chitosan is insoluble in alkaline solutions at pH levels above 6.5. Chitosan products are highly viscous, resembling natural gums[4].

Production, Use, and Human Exposure

Chitin, from which chitosan is derived, is a naturally occurring carbohydrate polymer second only to cellulose in abundance. Chitin is a structural component found in the exoskeleton of arthropods and in the cell walls of fungi and yeast[2]. The primary unit of chitin, *N*-acetyl-D-glucosamine, forms the polymeric structure via 1 → 4 glycosidic bonds. Discarded crab and shrimp shells from the seafood industry are the primary source material of chitin for the commercial production of chitosan[5]. For chitosan production, seafood shells are deproteinized by treatment with an aqueous 3% to 5% sodium hydroxide (NaOH) solution. The resulting product is neutralized and calcium is removed by treatment with an aqueous 3% to 5% hydrochloric acid (HCl) solution at room temperature resulting in a white or slightly pink precipitate of chitin. The *N*-deacetylation of chitin is done by treatment with an aqueous 40% to 45% NaOH solution, and the precipitate is washed with water. The precipitate is then dissolved in aqueous 2% acetic acid and the insoluble material is removed. The resulting clear supernatant solution is neutralized with aqueous NaOH solution producing chitosan as a white precipitate.

Chitosan is used in a wide range of products including use as a flocculating agent for water and waste treatment and as a chelating agent for removal of traces of heavy metals from aqueous

solutions[4]. In agriculture, chitosan is used as a plant growth regulator through foliar application and as an antimicrobial agent and a time-release reservoir for fertilizers in soil amendments.

Chitosan has several current or proposed biomedical applications. Chitosan is considered to be hemostatic due to its cationic nature. As such, wound dressings manufactured from chitosan are available for clinical use[6]. Several drug delivery systems based on chitosan nanoparticles are currently being investigated. Chitosan nanoparticles are capable of permeating the blood brain barrier, and the mucoadhesive properties of chitosan have been shown to enhance drug absorption[2; 7]. Chitosan has also been evaluated for the manufacture of ocular bandage lenses and biodegradable surgical and dental implants[8].

In cosmetics, chitosan is used in a variety of hair and skin products, including hair and body washes, coloring shampoos, and agents for skin cleaning and protection[9]. Chitosan has also been evaluated for use as an additive to toothpaste for prevention of enamel erosion[10].

As a dietary supplement, chitosan is marketed and sold in weight-loss products, but the mechanism behind chitosan-induced inhibition of fat digestion is not well understood. It has been proposed that chitosan acts as a weak anion exchanger and decreases intestinal cholesterol absorption while also increasing the excretion of bile acids[11-13]. Another possible mechanism is that chitosan traps fat in the intestines by increasing the viscosity of the intestinal contents and preventing the hydrolysis of triglycerides[13-15]. The manufacturer-recommended consumption of chitosan as a weight-loss product in humans typically averages 1,000 mg per day, or approximately 14.3 mg/kg per day (based on a 70 kg adult)[16; 17]. There are no available dose or prevalence data for human consumption of chitosan as a dietary supplement.

Absorption, Distribution, Metabolism, Excretion, and Toxicokinetics

The systemic absorption and distribution of chitosan following oral exposure are likely influenced by the molecular weight of the polymer. The effect of molecular weight on chitosan absorption has been evaluated in male Sprague Dawley rats. Oral gavage administration of chitosan with molecular weights of 3.8, 7.5, 13, 22, or 230 kDa resulted in maximum plasma chitosan concentrations (C_{max}) of 20.23, 9.30, 5.86, 4.32, or less than 0.5 µg/mL, respectively[18]. The results of this study suggest that the absorption of chitosan from the gastrointestinal tract following oral exposure is inversely related to chitosan molecular weight, as there is likely low bioavalability associated with the higher molecular weight chitosan polymers.

The biodegradation of chitosan influences absorption and distribution because both are dependent on molecular weight. The biodegradation of chitosan in vivo is dependent on the degree of deacetylation[19]. Enzymatic degradation of chitosan depends on the ability to hydrolyze glucosamine-glucosamine, glucosamine-*N*-acetyl-glucosamine and *N*-acetyl-glucosamine-*N*-acetyl-glucosamine linkages[1]. Degradation of chitosan in vertebrates is thought to occur predominantly by lysozymes and bacterial enzymes in the colon[1]. While eight human chitinases have been identified with three showing enzymatic activity, their capacity to degrade chitosan has not been investigated[1; 20].

Toxicity

Experimental Animals

The acute toxicities of chitosan and chitosan oligomers prepared by enzymatic depolymerization of chitosan have been evaluated. Hirano[5] reported the oral LD_{50} for chitosan as 16 g/kg body weight in mice. No clinical signs of toxicity were observed following a single oral administration of chitosan oligomers up to 10 g/kg in male and female Kunming strain mice[21].

No significant differences in weight gain were observed between exposed male Charles River albino rats and the controls in a 4-week study with 1% or 5% dietary chitosan[22]. In male Wistar rats, no significant differences in growth, feed intake, liver weight, or dried fecal weight were observed between control and chitosan-fed (2% or 5%) animals after 21 days[23]. In male Sprague Dawley rats fed chitosan in the diet for 8 weeks, no toxicity was observed in animals at concentrations up to 5%, progressive growth reductions and clinical pathology disturbances occurred at 10% and 15%, and enlargement of the liver and kidneys was observed at 15%[24].

In female BALB/c mice fed a 5% (4.4 ± 0.7 g/day per animal) chitosan diet for 4 weeks, body weight reduction correlated with significantly decreased feed consumption and alterations in normal gut flora[25].

In a study to evaluate mineral and fat-soluble vitamin status in male Charles River Japan Sprague Dawley rats, exposure to a diet containing 5% chitosan for 2 weeks caused a decrease in mineral absorption and bone mineral content[26]. Decreased serum vitamin E was observed in rats fed 5% chitosan with ascorbic acid supplementation in the diet. Serum vitamin E depletion was not observed in rats given glucosamine instead of chitosan.

Depletion of fat-soluble vitamins has been associated with a variety of neurologic and metabolic disorders. Male C57BL/6 mice fed a vitamin E-deficient diet showed signs of cognitive decline after 3 months of exposure and had increased lipid peroxidation products in brain tissue after 6 months of exposure[27]. Male rats fed a vitamin A-deficient diet for 3 months had lower levels of serum cholesterol, HDL-cholesterol, and triacylglycerol, as well as decreased synthesis of liver fatty acids[28].

The toxicity of glucosamine oligomers has been evaluated in male and female Charles River Japan F344 rats fed 0%, 0.04%, 0.2%, or 1% oligoglucosamine in the diet for 90 days[29]. Glucosamine oligomers are prepared by hydrolysis of chitosan and, similar to the chitosan utilized in this 6-month study, are considered low molecular weight chitosan. In the 1% (653.1 mg/kg per day in males, 719.8 mg/kg per day in females) group, erythema and edema in the snout and on the forelimbs and loss of fur on the forelimbs were observed in both male and female rats. Neutrophilic infiltration in the nasal cavity was also observed in both sexes in the 1% group. These findings were considered to be caused by topical exposure to glucosamine oligomers during feeding and grooming. Decreased feed consumption and body weight gain were also observed in animals in the 1% group in this study and were thought to be the result of feeding difficulty due to the snout and forelimb lesions described above. Rats receiving 1% oligoglucosamine also displayed lower weights of the uterus, ovary, seminal vesicles, and testes (with fewer germ cells).

The intravenous administration of chitosan has been investigated due to the development of chitosan formulations for drug delivery. No adverse effects were reported in rabbits up to 60 days following intravenous administration of chitosan oligosaccharides (prepared by oxidative depolymerization of chitosan) at doses up to 8.6 mg/kg daily for 5 consecutive days[30]. In this study, increased lysozyme activity was observed in rabbit serum collected the day after the last intravenous injection. Chemical modifications and nanoparticle suspensions of chitosan are currently being investigated for drug delivery[1]. As such, modifications made to chitosan could alter the toxicity of the unmodified chitosan polymer.

No adverse effects of chitosan were reported in eye or skin irritation tests in rabbits or guinea pigs, respectively[31].

Humans

Studies designed to evaluate the effectiveness of chitosan as a weight-loss supplement suggest that chitosan is well tolerated in humans. No adverse effects were reported in male (4.5 g chitosan per day) or female (2.5 g per day) volunteers following oral chitosan administration for 12 days[32; 33]. Additionally, no adverse effects were reported following oral administration of chitosan at up to 6.75 g per day for 8 weeks in male and female volunteers[34].

Carcinogenicity

No 2-year carcinogenicity studies of chitosan were identified in the available literature.

Carcinogenicity and chronic toxicity have been evaluated for *N*-acetyl-D-glucosamine, a monomeric constituent of chitosan. F344 rats administered *N*-acetyl-D-glucosamine at concentrations up to 5% in the diet (1,935 mg/kg per day in males and 2,244 mg/kg per day in females) for 104 weeks had no associated increases in tumor response[35]. In a second study in F344 rats, administration of *N*-acetyl-D-glucosamine in feed at concentrations up to 5% in the diet (2,323 mg/kg per day in males and 2,545 mg/kg per day in females) for 52 weeks did not induce an increase in tumor response[35].

Developmental and Reproductive Toxicity

A limited number of developmental and reproductive toxicity studies were identified in the literature.

In a multigenerational prenatal and postnatal assessment of high molecular weight chitosan (HMWCS), F_0 time-mated ICR mice were administered 0, 125, 500, or 2,000 mg/kg HMWCS via a single intraperitoneal injection on gestational day 6 (GD 6) and subjected to a laparotomy or allowed to litter[36]. F_1 offspring (1 mouse/sex per litter) from the same exposure group were mated and females similarly subjected to either a laparotomy or allowed to litter to produce an F_2 generation. F_0 dams in the 2,000 mg/kg group exhibited signs of maternal toxicity (mortality and diarrhea). F_0 dams in the 500 and 2,000 mg/kg groups displayed dose-dependent increases in vaginal bleeding, postimplantation loss, and lower spleen weights. Fetal weights for both generations were lower in the 2,000 mg/kg group. There were no external, visceral, or skeletal malformations attributed to chitosan administration. F_0 dams allowed to litter displayed a dose-related reduction in litter size. F_1 mice exposed in utero to 2,000 mg/kg HMWCS and examined on postnatal day 21 (PND 21) exhibited higher uterus, ovary, and thymus weights. Female F_1

mice exposed in utero to 2,000 mg/kg HMWCS displayed lower thymus weights on PND 56. F_2 mice exposed in utero to 2,000 mg/kg HMWCS displayed lower testis and ovary weights on PNDs 21 and 56.

Chitosan oligomers did not induce morphologic sperm abnormalities in male mice following oral gavage daily for 5 days with up to 5,000 mg/kg[21].

The effects of chitosan nanoparticles (spherical; 200 ± 6 nm or 340 ± 10 nm diameter) have been examined in zebrafish (Danio rerio) embryos. Embryos exposed 4 to 5 hours after fertilization to 0, 5, 10, 20, 30, or 40 µg/mL (200 nm particles) or 0, 10, 20, or 40 µg/mL (340 nm particles) displayed concentration-dependent decreases in hatching rates and increases in mortality 96 hours after exposure[37]. Increased rates of cell death and reactive oxygen species production were observed in all exposure groups. Exposure to 200 nm, but not 340 nm, chitosan nanoparticles induced developmental malformations in embryos, including bent spines, pericardial edema, and opaque yolks.

Genetic Toxicity

No in vitro or in vivo studies evaluating chitosan for mutagenic effects were identified in the available literature.

Chitosan oligomers were negative at concentrations up to 5,000 µg/plate in Salmonella typhimurium strains TA97, TA98, TA100, and TA102 with and without rat liver S9 metabolic activation enzymes, and they were negative for micronucleus induction in mouse bone marrow following oral gavage for 2 days at up to 5,000 mg/kg[21].

Study Rationale

Chitosan was nominated for study by the National Cancer Institute due to widespread human exposure, especially through use as a dietary supplement for body weight reduction, and for concerns regarding potential vitamin E and bone mineral depletion following ingestion. NTP conducted a 6-month study evaluated the effects of dietary chitosan on the development of osteopenia/osteoporosis, fat and calcium absorption, fat-soluble vitamin depletion, and general toxicity effects in Charles River Sprague Dawley rats.

Materials and Methods

Procurement and Characterization of Chitosan

Chitosan was obtained from Vanson HaloSource, Inc. (Redmond, WA), in one lot (02-ASSF-0715), which was used in the 6-month study. Identity, purity, and stability analyses were conducted by the analytical chemistry laboratory at Midwest Research Institute (MRI) (Kansas City, MO) and by the study laboratory at Battelle Columbus Operations (Columbus, OH) (Appendix F). Reports on analyses performed in support of the chitosan studies are on file at the National Institute of Environmental Health Sciences.

The test article, an off-white powder, was identified using infrared and proton nuclear magnetic resonance (NMR) spectroscopy. The percentage of deacetylation of the test article, determined by proton NMR, ranged from 85.97% to 87.17%, with an average of 86.5%. All spectra were consistent with the literature spectra[38; 39], and with the Sadtler spectral database.

The moisture content for lot 02-ASSF-0715 was determined using weight loss on drying, the inorganic content was determined on the dried test article by ashing, viscosity was determined using a Brookfield viscometer, and the most abundant molecular weight was determined using gel permeation chromatography (GPC) with refractive index (RI) detection.

Moisture content was 4.50% water, the average inorganic content was 2.13%, and viscosity was 81.3 centipoise. GPC/RI indicated one major peak and the determined molecular weight of the bulk chemical ranged from 62,755 to 87,343 daltons (Da). This resulted in an average molecular weight of 81,644 g/mol, or approximately 82 kDa, classifying the test article as a low molecular weight chitosan (LMWCS). A sample of lot 02-ASSF-0715 was submitted to Covance Laboratories, Inc. (Madison, WI), for nutritional and contaminant testing using standard methods. Levels of organochlorine and organophosphorous pesticides, nitrosamines, and aflatoxins were below the detection limits of the analytical methods. The purity of lot 02-ASSF-0715 was estimated to be approximately 94% based on the analysis of moisture and inorganic content. Taken together, these data indicated that the test article was chitosan.

To ensure stability, the test article was stored in sealed amber glass vials at room temperature. Reanalysis of the test article was performed during the study using GPC/RI and no degradation of the test article was detected.

Preparation and Analysis of Dose Formulations

The dose formulations were prepared approximately monthly by mixing chitosan with feed. Dose formulations were stored in lined plastic buckets sealed with lids and stored at −30°C to −15°C for up to 42 days.

Homogeneity studies of approximately 0.5% and 9% formulations (5,046 and 90,049 µg/g, respectively) and stability studies of an approximately 0.5% (5,046 µg/g) formulation were performed by the analytical chemistry laboratory using GPC/RI. Two peaks were attributed to chitosan with retention times of approximately 6.9 minutes and 12.1 minutes, respectively. Chitosan quantitation was based on the larger polymeric components of the first peak only because vehicle components co-eluted with the later oligomeric peak. Homogeneity studies of

1% and 9% (10 and 90 mg/g in feed, respectively) dose formulations were performed by the study laboratory using GPC/RI. Homogeneity was confirmed, and stability was confirmed for at least 42 days for dose formulations stored in lined plastic buckets sealed with lids at temperatures up to room temperature and for at least 7 days under simulated animal room conditions.

Periodic analyses of the dose formulations of chitosan were performed by the study laboratory using GPC/RI. Of the dose formulations analyzed, all nine were within 10% of the target concentrations (Table F-3). Animal room samples were also analyzed; all three were within 10% of the target concentrations.

Animal Source

Male and female Sprague Dawley [Crl:CD(SD)] rats were obtained from Charles River Laboratories (Portage, MI) for use in the 6-month study.

Animal Welfare

Animal care and use are in accordance with the Public Health Service Policy on Humane Care and Use of Animals. All animal studies were conducted in an animal facility accredited by the Association for the Assessment and Accreditation of Laboratory Animal Care International. Studies were approved by the Battelle Columbus Operations Animal Care and Use Committee and conducted in accordance with all relevant NIH and NTP animal care and use policies and applicable federal, state, and local regulations and guidelines.

Six-month Study

The rats were 5 to 6 weeks old upon receipt. Rats were quarantined for 12 to 15 days and were 7 to 9 weeks old on the first day of the study. Before the study began, five male and five female rats were randomly selected for parasite evaluation and gross observation for evidence of disease. The health of the animals was monitored during the study according to the protocols of the NTP Sentinel Animal Program (Appendix I). A positive test result for parvovirus occurred in one animal at the 4-week timepoint. Additional testing of serum from this animal and other sentinel animals via other testing methodologies deemed the original positive result to be a false positive. All other test results were negative for rodent pathogens.

The animals in this study were split into three groups, the core group, Group A, and two special study groups, Groups B (vitamin and bone analysis) and C (fat digestion, hematology, clinical chemistry, and urinalysis). Different parameters were evaluated in each group, which allowed for the collection of extensive endpoints (Table 1). Groups of 10 male and 10 female rats were examined per endpoint and there was no crossover of analyses between any of the groups. Group A rats were fed diets containing 0%, 1%, 3%, or 9% chitosan for 25 weeks. Groups B and C rats were fed diets containing the same concentrations for up to 26 weeks. Feed and water were available ad libitum. The AIN-93M diet was used for this study instead of the NTP-2000 diet because of the high levels of fat-soluble vitamins and higher total fat content found in the NTP-2000 diet. The NTP-2000 feed contains almost double the amount of required fat-soluble vitamins and has a higher fat content (7% to 8%) than the AIN-93M feed (4%)[40-42]. One of the primary rationales for this chitosan study was the potential for decreases in fat-soluble vitamin

concentrations, and therefore, utilizing a diet with lower levels of preexisting vitamins and a lower fat content was ideal to avoid confounding potential results. Rats were housed individually. Feed consumption was recorded weekly for core study rats. Core study rats were weighed and clinical findings were recorded initially, on day 8, weekly thereafter, and at the end of the study. Details of the study design and animal maintenance are summarized in Table 2.

Table 1. Distribution of Evaluated Parameters

	Group		
Parameter	**A**	**B**	**C**
Feed consumption	X	–	–
Body weights	X	–	–
Clinical findings	X	–	–
SMVCE	X	–	–
Bone histomorphometry	X	–	–
Gross lesions and histopathology	X	–	–
Vitamin A (serum and liver)	–	X	–
Vitamin E (serum and liver)	–	X	–
1,25 $(OH)_2$ Vitamin D (serum)	–	X	–
Bone calcium, ash, and moisture	–	X	–
Hematology	–	–	X
Clinical chemistry	–	–	X
Vitamin K_1 (plasma and liver)	–	–	X
Feed and fecal analysis	–	–	X
Urinalysis	–	–	X

On the first day of weeks 7, 13, 19, and 26, blood was collected from all Group B rats via the retroorbital plexus under CO_2/O_2 anesthesia for determination of vitamins A, E, and 1,25 $(OH)_2$ vitamin D concentrations. Blood was collected into tubes, allowed to clot, and centrifuged. Sera were stored at approximately −70°C until analysis. Blood samples for vitamin K_1 concentrations in Group C rats, collected into tubes containing EDTA at the same time as hematology collections, were centrifuged; the plasma was harvested, snap frozen, and stored at −70°C protected from light. At study termination (week 26), liver samples were collected from surviving Group B and C rats, processed, and stored frozen for determination of vitamins A and E (Group B) or vitamin K_1 (Group C) concentrations. Blood and liver samples were analyzed by high performance liquid chromatography for vitamins A and E (Covance Laboratories, Inc.), by competitive enzyme immunoassay for 1,25 $(OH)_2$ vitamin D (Antech Diagnostics, Morrisville, NC), or by gas chromatography/mass spectrometry for vitamin K_1 (Analytics, Inc., Gaithersburg, MD). Because most values for vitamin K_1 were below the limit of quantitation, the results are not presented in this Toxicity Study Report.

For 8 days beginning during weeks 6, 12, 18, and 24, Group C rats were placed in metabolism cages (Nalgene Company, Rochester, NY) for fecal and urine collection. During collection periods, rats were allowed control or dosed feed and water ad libitum, and feed samples were collected. Feces were collected for a period of 8 days, with each day's collection being combined with previous days' collection and stored at approximately −20°C. Feces were stored at −70°C after each collection period until shipping to Covance Laboratories, Inc., on dry ice for analyses of calcium, fat, and moisture; the feed samples were also sent for analysis. Fat content in feed and feces was determined gravimetrically by Soxhlet extraction. Feed consumption, fat intake [(total feed consumed per interval) × (% fat in feed/100)], and fat excretion [fecal weight × (% fecal fat/100)], were calculated to estimate fat digestion: {[(fat intake − fat excreted in feces)/fat intake] × 100}. Calcium concentrations in feed and feces were determined using inductively coupled plasma emission spectrometry. Moisture was determined by weight loss upon drying. Urine was collected on ice for each Group C rat over a 24-hour period during the last day in the metabolism cage and coincided with the last day of fecal collection. Total urine collected was transferred to centrifuge tubes and the volume was recorded. Urine creatinine was measured using a Hitachi 911™ chemistry analyzer (Roche Diagnostics, Indianapolis, IN), and deoxypyridinoline was measured using a Metra Total DPD Enzyme Immunoassay Kit (Quidel, San Diego, CA).

On the last day in the metabolism cage, at the beginning of weeks 7, 13, 19, and 25, blood was collected from all Group C rats via the retroorbital plexus under CO_2/O_2 anesthesia for hematology (week 25 only) and clinical chemistry. Blood samples for hematology were collected in tubes containing EDTA as an anticoagulant. Hematology parameters were determined using an Advia 120 hematology analyzer (Bayer Diagnostics Division, Tarrytown, NY). Blood for clinical chemistry determinations was collected in tubes without anticoagulant, allowed to clot, and centrifuged and then the serum was harvested. Except as noted, clinical chemistry parameters were determined using a Hitachi 911™ chemistry analyzer (Roche Diagnostics). For osteocalcin and parathyroid hormone, serum was stored frozen at −20°C until analysis. Serum osteocalcin was measured using a Rat-MID™ Osteocalcin ELISA (Nordic Bioscience Diagnostics, Herlev, Denmark). Serum parathyroid hormone was measured using an Intact PTH Enzyme Immunoassay Kit (ALPCO Diagnostics, Salem, NH).

At study termination (week 26), right and left femurs were collected from the Group B rats for determination of calcium, ash, and moisture. Covance Laboratories, Inc., determined bone moisture by measuring weight loss upon drying, calcium by inductively coupled plasma emission spectrometry, and ash gravimetrically.

At the end of the study (week 25), samples were collected for sperm motility and vaginal cytology evaluations on Group A rats. The parameters evaluated are listed in Table 2. Due to inconsistent sample collection and slide staining, an assessment of estrous cyclicity could not be made. Male animals were evaluated for sperm count and motility. The left testis and left epididymis were isolated and weighed. The tail of the epididymis (cauda epididymis) was then removed from the epididymal body (corpus epididymis) and weighed. Test yolk was applied to slides and a small incision was made at the distal border of the cauda epididymis. The sperm effluxing from the incision were dispersed in the buffer on the slides, and the numbers of motile and nonmotile spermatozoa were counted for five fields per slide by two observers. Following completion of sperm motility estimates, each left cauda epididymis was placed in buffered saline solution. Caudae were finely minced, and the tissue was incubated in the saline solution and then

heat fixed at 65°C. Sperm density was then determined microscopically with the aid of a hemacytometer. To quantify spermatogenesis, the testicular spermatid head count was determined by removing the tunica albuginea and homogenizing the left testis in phosphate-buffered saline containing 10% dimethyl sulfoxide. Homogenization-resistant spermatid nuclei were counted with a hemacytometer.

Necropsies were performed on all Group A animals at study termination (week 25). The heart, right kidney, liver, lung, right ovary, parathyroid gland, right testis, thymus, thyroid gland and parathyroid gland together, and uterus were weighed. Both tibias and both femurs were collected; the lengths of both tibias and the left femur were measured. The right tibia and femur were dehydrated in ethanol (70% to 100%) and infiltrated with glycol methacrylate. Tissues for microscopic examination were fixed and preserved in 10% neutral buffered formalin (except eyes were first fixed in Davidson's solution), processed and trimmed, embedded in paraffin, sectioned to a thickness of 4 to 6 μm, and stained with hematoxylin and eosin. Complete histopathologic examinations were performed by the study laboratory pathologist on 0% and 9% rats. The kidney and liver of males and females and the parathyroid gland and prostate gland of males were examined in all exposure groups. Table 2 lists the tissues and organs routinely examined.

After a review of the laboratory reports and selected histopathology slides by a quality assessment (QA) pathologist, the findings and reviewed slides were submitted to an NTP Pathology Peer Review (PPR) coordinator for a second independent review. Any inconsistencies in the diagnoses made by the study laboratory and QA pathologists were resolved by the NTP pathology peer review process. Final diagnoses for reviewed lesions represent a consensus of the PPR or a consensus between the study laboratory pathologist, NTP pathologist, QA pathologist(s), and the PPR coordinator. Details of these review procedures have been described, in part, by Maronpot and Boorman[43] and Boorman et al.[44].

Table 2. Experimental Design and Materials and Methods in the Six-month Feed Study of Chitosan

Six-month Studies
Study Laboratory
Battelle Columbus Operations (Columbus, OH)
Strain and Species
Charles River Sprague Dawley [Crl:CD(SD)] rats
Animal Source
Charles River Laboratories (Portage, MI)
Time Held Before Study
Group A (core study): 14 (males) or 15 (females) days Groups B and C (special studies): 12 (males) or 13 (females) days
Average Age When Study Began
7 to 8 weeks (Group A males and Groups B and C males and females) 8 to 9 weeks (Group A females)
Date of First Exposure
Group A: August 31 (males) or September 1 (females), 2006 Groups B and C: August 29 (males) or 30 (females), 2006
Duration of Exposure
Group A: 25 weeks Groups B and C: 26 weeks
Date of Last Exposure
Group A: February 15 (males) or 16 (females), 2007 Groups B and C: February 20 (males) or 21 (females), 2007
Necropsy Dates
Group A: February 15 (males) or 16 (females), 2007 Groups B and C: February 20 (males) or 21 (females), 2007
Average Age at Necropsy
32 to 33 weeks (Group A females and Groups B and C males and females) 31 to 32 weeks (Group A males)
Size of Study Groups
10 males and 10 females
Method of Distribution
Animals were distributed randomly into groups of approximately equal initial mean body weights.
Animals per Cage
1
Method of Animal Identification
Tail tattoo
Diet
AIN-93M maintenance purified meal diet (Purina TestDiet, Richmond, IN), available ad libitum, changed twice weekly
Water

Six-month Studies

Tap water (Columbus, OH municipal supply) via automatic watering system (Edstrom Industries, Inc. Waterford, WI), available ad libitum

Cages

Polycarbonate solid-bottom (Lab Products, Inc., Seaford, DE), changed weekly, rotated in rack every 2 weeks

Bedding

Irradiated hardwood bedding chips (P.J. Murphy Forest Products Corporation, Montville, NJ), changed weekly

Rack Filters

Spun-bonded polyester (Snow Filtration Company, Cincinnati, OH), changed every 2 weeks

Racks

Stainless steel (Lab Products, Inc), changed and rotated every 2 weeks

Animal Room Environment

Temperature: 72° ± 3°F
Relative humidity: 50% ± 15%
Room fluorescent light: 12 hours/day
Room air changes: 10/hour

Exposure Concentrations

0%, 1%, 3%, and 9% in feed, available ad libitum

Type and Frequency of Observation

Observed twice daily; Group A rats were weighed and clinical findings were recorded initially, on day 8, weekly thereafter, and at the end of the study. Feed consumption was recorded weekly for Group A rats and during fecal collection periods for Group C rats.

Method of Euthanasia

100% Carbon dioxide

Necropsy

Necropsies were performed on all Group A rats at the end of the study (week 25). Organs weighed were heart, right kidney, liver, lung, right ovary, parathyroid gland, right testis, thymus, thyroid gland and parathyroid gland together, and uterus. Lengths of both tibias and the left femur were measured.

Clinical Pathology

Blood was collected via the retroorbital plexus from all Group C rats on the first day of weeks 7, 13, 19, and 25 for hematology (week 25 only) and clinical chemistry. Urine was collected from Group C rats for 24 hours beginning the last day of weeks 6, 12, 18, and 24.
Hematology: hematocrit (auto and manual); hemoglobin concentration; erythrocyte, reticulocyte, and platelet counts; mean cell volume; mean cell hemoglobin; mean cell hemoglobin concentration; and leukocyte count and differentials
Clinical chemistry: urea nitrogen, creatinine, calcium, phosphorous, total protein, albumin, cholesterol, triglycerides, alanine aminotransferase, alkaline phosphatase, creatine kinase, sorbitol dehydrogenase, bile acids, total osteocalcin, and parathyroid hormone
Urinalysis: creatinine, volume, and deoxypyridinoline

Histopathology

Six-month Studies
Histopathology was performed on 0% and 9% Group A rats. In addition to gross lesions and tissue masses, the following tissues were examined: adrenal gland, bone (left femur and tibia) with marrow, brain, clitoral gland, esophagus, eye, Harderian gland, heart and aorta, large intestine (cecum, colon, rectum), small intestine (duodenum, jejunum, ileum), kidney, liver, lung (with mainstem bronchus), lymph nodes (mandibular and mesenteric), mammary gland, nose, ovary, pancreas, parathyroid gland, pituitary gland, preputial gland, prostate gland, salivary gland, seminal vesicle, skin, spleen, stomach (forestomach and glandular), testis (with epididymis), thymus, thyroid gland, trachea, urinary bladder, and uterus. The kidney and liver of males and females and the parathyroid gland and prostate gland of males were also examined in the 1% and 3% groups.
Sperm Motility
At the end of the study, sperm samples were collected from male Group A rats for sperm count and motility evaluations. The following parameters were evaluated: spermatid heads per gram testis and per testis, spermatid heads per gram cauda and per cauda, and epididymal spermatozoal motility. The left cauda, left epididymis, and left testis were weighed.
Digestion Studies
Feces were collected from Group C rats for 8 days beginning weeks 6, 12, 18, and 24 and analyzed for calcium, fat, and moisture. Fecal calcium and fat content were compared to that in feed samples collected during the same time period to produce values for fat digested and calcium absorbed.
Serum and Hepatic Vitamins
Blood was collected from the retroorbital plexus of Groups B and C rats on the first day of weeks 7, 13, 19, and 25 (Group C), and 26 (Group B). At study termination (week 26), liver samples were collected from Groups B and C rats. Blood and liver samples were analyzed for vitamins A, E, 1,25 $(OH)_2$ D, and/or K_1.
Bone Analysis
At study termination (week 26), right and left femurs were collected from Group B rats, and calcium, ash, and moisture levels were measured.

Statistical Methods

Calculation and Analysis of Lesion Incidences

The incidences of lesions are presented in Appendix A as the numbers of animals bearing such lesions at a specific anatomic site and the numbers of animals with that site examined microscopically. The Fisher exact test[45], a procedure based on the overall proportion of affected animals, was used to determine significance.

Analysis of Continuous Variables

Two approaches were employed to assess the significance of pairwise comparisons between dosed and control groups in the analysis of continuous variables. Organ and body weight data, which historically have approximately normal distributions, were analyzed with the parametric multiple comparison procedures of Dunnet[46] and Williams[47; 48]. Hematology, clinical chemistry, urinalysis, serum and liver vitamin concentrations, digestive and bone parameters, spermatid, and epididymal spermatozoal data, which have typically skewed distributions, were analyzed using the nonparametric multiple comparison methods of Shirley[49] (as modified by Williams[50]) and Dunn[51]. Jonckheere's test[52] was used to assess the significance of the dose-related trends and to determine whether a trend-sensitive test (Williams' or Shirley's test) was more appropriate for pairwise comparisons than a test that does not assume a monotonic dose-related trend (Dunnett's or Dunn's test). Prior to statistical analysis, extreme values identified by the outlier test of Dixon

and Massey[53] were examined by NTP personnel, and implausible values were eliminated from the analysis.

Quality Assurance Methods

The 6-month study was conducted in compliance with Food and Drug Administration Good Laboratory Practice Regulations[54]. In addition, as records from the 6-month study were submitted to the NTP Archives, this study was audited retrospectively by an independent QA contractor. Separate audits covered completeness and accuracy of the pathology data, pathology specimens, final pathology tables, and a draft of this NTP Toxicity Study Report. Audit procedures and findings are presented in the reports and are on file at NIEHS. The audit findings were reviewed and assessed by NTP staff, and all comments were resolved or otherwise addressed during the preparation of this Toxicity Study Report.

Results

Six-month Study

All male and female Group A rats survived to the end of the study (Table 3); however, five rats from Groups B and C died, often after seizures that occurred near the time of blood collection, with the cause of death undetermined. There were no treatment-related clinical findings in Group A animals, although 13 animals from Groups B and C (10 from the 9% group, one from the 3% group, and two from the 1% group) were observed with seizures either during or after the 18-week blood collections. Seizures were not noted at any other time point. Body weights and feed consumption were measured in Group A rats, and mean body weights of exposed males and females were not significantly different from those of the control groups (Table 3 and Figure 2). Feed consumption by 3% and 9% Group A males was greater than that by the controls, but the increase may not be accurate due to observed food spillage possibly due to poor palatability resulting in feed being wasted (Table G-1). Dietary concentrations of 1%, 3%, and 9% resulted in average daily doses of approximately 450, 1,500, and 5,200 mg chitosan/kg body weight per day to males and 650, 1,800, and 6,000 mg/kg per day to females, respectively.

Table 3. Survival, Body Weights, and Feed Consumption of Group A Rats in the Six-month Feed Study of Chitosan[a]

Concentration	Survival[b]	Initial Body Weight (g)	Final Body Weight (g)	Change in Body Weight (g)	Final Weight Relative to Controls (%)	Feed Consumption Week 1	Feed Consumption Week 25
Male							
0%	10/10	238 ± 5	669 ± 20	432 ± 18		22.2	21.2
1%	10/10	243 ± 6	702 ± 21	459 ± 17	105	23.8	20.4
3%	10/10	242 ± 6	687 ± 23	445 ± 21	103	23.6	24.7
9%	10/10	243 ± 6	612 ± 17	369 ± 17	91	21.4	27.3
Female							
0%	10/10	175 ± 3	338 ± 11	162 ± 12		17.7	16.4
1%	10/10	173 ± 2	335 ± 13	162 ± 12	99	22.3	20.3
3%	10/10	177 ± 4	328 ± 11	151 ± 9	97	17.3	17.1
9%	10/10	177 ± 2	301 ± 13	124 ± 12	89	16.9	18.8

[a]Weights and weight changes are given as mean ± standard error. Feed consumption is expressed as grams per animal per day. Differences in weights and weight changes from the control group are not significant by Dunnett's test.
[b]Number of animals surviving at 25 weeks/number initially in group.

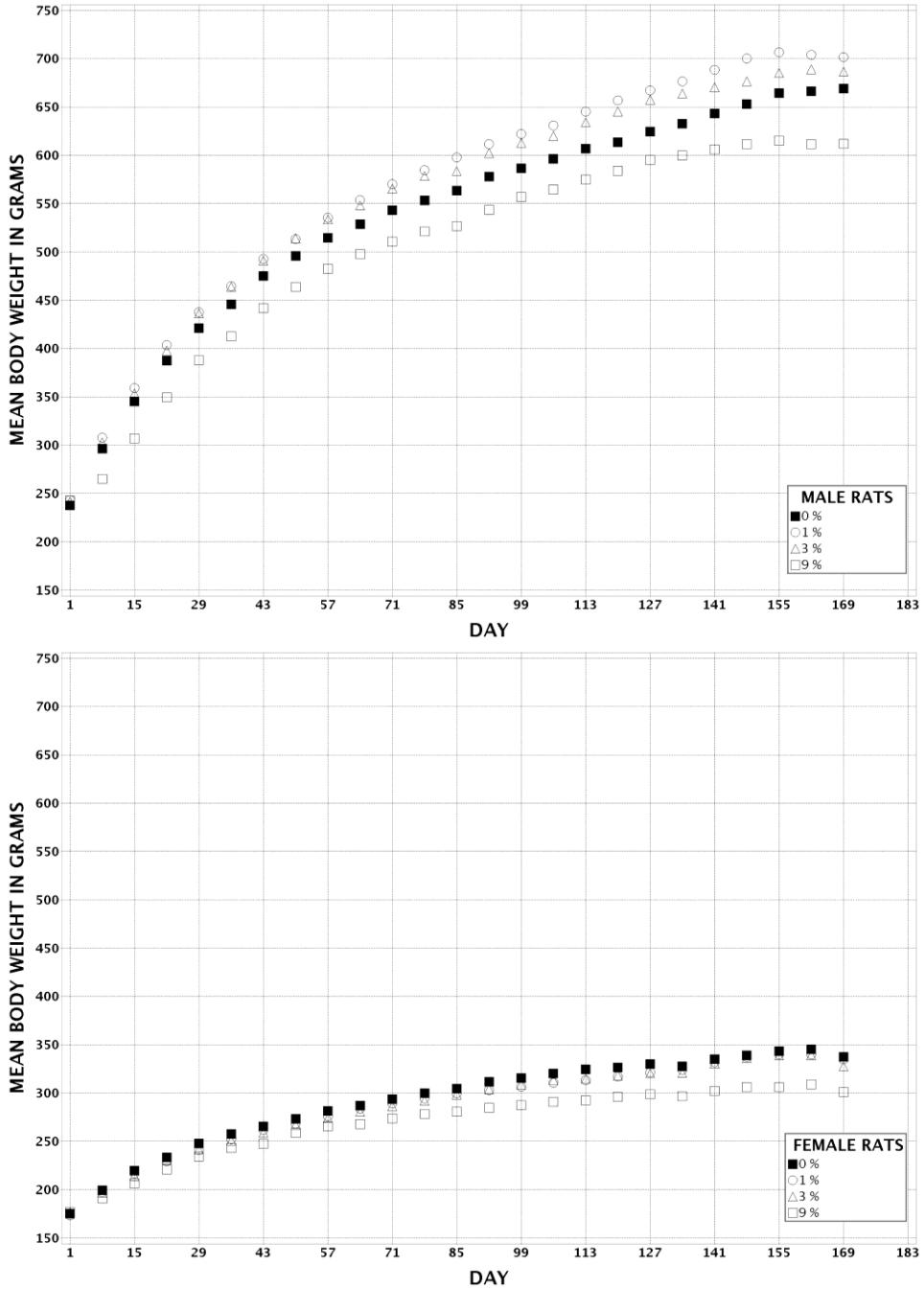

Figure 2. Growth Curves for Group A Rats Exposed to Chitosan in Feed for Six Months

Hematology data for Group C rats are listed in Table B-1. Compared to the control group, mild significant increases (4% to 6%) in automated hematocrit, hemoglobin concentration, mean cell volume, and mean cell hemoglobin were observed in 9% males; manual hematocrit and erythrocyte count were similar to those of the controls. These changes may be due to biological variability and are likely not toxicologically relevant. All other differences from control values in the male and female hematology data were mild or sporadic and not considered toxicologically significant.

Clinical chemistry data for Group C rats are listed in Table 4 and Table B-1. Both the 9% male and female rats had significantly decreased cholesterol values (26% to 48%), compared to the controls, at all time points. Triglycerides values were also significantly decreased in the 9% male (47% to 57%) and female (30%) rats, but not at every time point. Phosphorus levels were significantly decreased in the 9% male rats at weeks 13, 19, and 25 (12% to 18%); a decrease also occurred in the 3% males at week 13 (14%). Similarly, phosphorus levels were significantly decreased in the 3% and 9% females at weeks 13 (20% and 16%, respectively) and 25 (9% and 19%, respectively). A mild, but statistically significant, decrease (4%) in calcium concentration was observed in 9% males at weeks 19 and 25. Alanine aminotransferase (ALT) activity, a marker of hepatocellular injury, was mildly but significantly elevated at week 25 in the 9% male rats (104%) and in the 3% and 9% female rats (28% and 88%, respectively). However, sorbitol dehydrogenase (another marker of hepatocellular injury) was not significantly increased relative to the controls, and hepatocellular changes associated with increases in ALT were not observed microscopically. Thus, the toxicologic significance of the increases in ALT is uncertain. Urea nitrogen was mildly increased in the 9% males (23%) and females (15%) at week 25. Minimal to mild significant alterations were also observed in several other parameters. These alterations were inconsistent or within the range of biological variability.

Total osteocalcin (a marker of bone turnover) and parathyroid hormone levels were analyzed in Group C rats and were occasionally elevated throughout the study. Total osteocalcin was significantly elevated in the 9% males (38%) at week 25, while parathyroid hormone levels were significantly elevated in 9% males (96%) at Week 19 and in 9% females (56%) at week 25 (Table 4 and Table B-1).

Urine deoxypyridinoline/creatinine ratios were calculated at weeks 7, 13, 19, and 25 for both males and females in Group C and were mostly unchanged (Table 4 and Table B-1). A significant increase, compared to the control group, occurred at week 25 in the 9% males (28%). In females, minimal increases and decreases occurred inconsistently across all time points with a significant increase at week 7 in the 9% group (42%) and significant decreases at weeks 13 (26%) and 19 (20%) in the 1% group compared to controls.

To calculate the deoxypyridinoline/creatinine ratios, urine volume, urine creatinine concentrations, and urine deoxypyridinoline concentrations were measured at weeks 7, 13, 19, and 25. Urine volume was significantly decreased in various male and female exposure groups throughout the study, but most consistently in the 9% chitosan group (approximately 40% to 60%). Increases in urine creatinine concentration tended to parallel the decreases in urine volume indicating proper kidney function.

Table 4. Selected Clinical Chemistry and Urinalysis Data for Group C Rats in the Six-month Feed Study of Chitosan[a]

	0%	1%	3%	9%
Male				
Clinical Chemistry				
n	10	10	10	10
Calcium (mg/dL)				
Week 13	12.6 ± 0.1	12.5 ± 0.1	12.3 ± 0.2	12.4 ± 0.2
Week 19	12.5 ± 0.1	12.3 ± 0.2	12.3 ± 0.1	12.0 ± 0.1*
Week 25	12.1 ± 0.1	12.1 ± 0.2	12.0 ± 0.1	11.6 ± 0.1*
Phosphorus (mg/dL)				
Week 13	8.4 ± 0.3	8.1 ± 0.3	7.2 ± 0.3**	7.4 ± 0.4*
Week 19	8.2 ± 0.4	7.7 ± 0.2	7.4 ± 0.3	6.7 ± 0.2**
Week 25	6.9 ± 0.3	6.8 ± 0.2	6.7 ± 0.1	5.8 ± 0.3**
Cholesterol (mg/dL)				
Week 7	82 ± 5	75 ± 8	80 ± 6	53 ± 3**
Week 13	95 ± 7	84 ± 8	90 ± 7	53 ± 2**
Week 19	101 ± 6	87 ± 10	94 ± 8	59 ± 4**
Week 25	95 ± 6	81 ± 8	90 ± 6	49 ± 4**
Triglycerides (mg/dL)				
Week 7	202 ± 28	234 ± 43	226 ± 30	88 ± 15*
Week 13	198 ± 33	202 ± 38	195 ± 24	86 ± 8**
Week 19	180 ± 26	218 ± 43	210 ± 29	95 ± 13*
Week 25	173 ± 18	207 ± 30	218 ± 24	109 ± 13
Alanine aminotransferase (IU/L)				
Week 25	28 ± 3	29 ± 2	29 ± 1	57 ± 2**
Sorbitol dehydrogenase (IU/L)				
Week 25	17 ± 3	17 ± 2	15 ± 1	14 ± 1
Total osteocalcin (ng/mL)				
Week 7	445.7 ± 17.2	439.8 ± 15.8	441.8 ± 18.2	520.4 ± 22.6
Week 13	306.2 ± 13.0	289.7 ± 28.6	245.4 ± 37.9	372.6 ± 23.4
Week 19	239.4 ± 12.4	225.7 ± 10.6	181.6 ± 26.8	269.2 ± 20.9
Week 25	158.3 ± 10.0	168.1 ± 11.6	145.9 ± 22.7	218.3 ± 14.6*
Parathyroid hormone (ng/mL)				
Week 7	1.882 ± 0.137	1.643 ± 0.449	1.838 ± 0.348	1.521 ± 0.368
Week 13	2.343 ± 0.350	2.763 ± 0.479	3.215 ± 0.537	2.433 ± 0.222
Week 19	1.879 ± 0.186	3.101 ± 0.475	2.710 ± 0.365	3.679 ± 0.361**
Week 25	2.668 ± 0.475	2.924 ± 0.276	3.981 ± 0.349	2.848 ± 0.506

	0%	1%	3%	9%
Urinalysis				
n				
Week 7	10	9	10	10
Week 13	10	10	10	10
Week 19	10	10	10	10
Week 25	10	10	10	10
Volume (mL)				
Week 7	8.3 ± 0.8	7.5 ± 1.5	6.4 ± 0.8	5.0 ± 1.1*
Week 13	7.9 ± 1.0	4.6 ± 0.3**	5.1 ± 0.4*	4.5 ± 0.5**
Week 19	10.7 ± 1.6	4.0 ± 0.4**	5.3 ± 0.7*	5.6 ± 0.6
Week 25	8.6 ± 1.2	5.4 ± 0.6*	6.1 ± 0.8*	5.1 ± 0.6**
Deoxypyridinoline/creatinine (nmol/mg)				
Week 7	1.810 ± 0.135	1.889 ± 0.148	1.810 ± 0.159	1.920 ± 0.160
Week 13	0.910 ± 0.035	0.890 ± 0.031	0.930 ± 0.040	0.960 ± 0.078
Week 19	0.530 ± 0.050	0.550 ± 0.034	0.570 ± 0.042	0.660 ± 0.048
Week 25	0.430 ± 0.030	0.470 ± 0.030	0.480 ± 0.020	0.550 ± 0.027**
Female				
Clinical Chemistry				
n				
Week 7	10	10	10	10
Week 13	10	10	10	10
Week 19	10	10	10	10
Week 25	10	9	10	10
Calcium (mg/dL)				
Week 13	12.9 ± 0.2	13.1 ± 0.1	12.7 ± 0.2	12.5 ± 0.2
Week 19	12.9 ± 0.1	13.1 ± 0.2	12.8 ± 0.1	12.5 ± 0.1
Week 25	12.7 ± 0.3	12.8 ± 0.1	12.7 ± 0.2	12.3 ± 0.2
Phosphorus (mg/dL)				
Week 13	8.1 ± 0.5	7.4 ± 0.4	6.5 ± 0.4**	6.8 ± 0.3*
Week 19	8.4 ± 0.4	8.2 ± 0.5	8.1 ± 0.3	7.4 ± 0.5
Week 25	6.8 ± 0.2	6.4 ± 0.2	6.2 ± 0.3*	5.5 ± 0.3**
Cholesterol (mg/dL)				
Week 7	80 ± 6	81 ± 8	67 ± 4	59 ± 4**
Week 13	92 ± 8	86 ± 7	73 ± 5	58 ± 4**
Week 19	107 ± 7	105 ± 9	91 ± 8	67 ± 5**
Week 25	94 ± 7	108 ± 5	96 ± 8	63 ± 4**

	0%	1%	3%	9%
Triglycerides (mg/dL)				
Week 7	88 ± 12	130 ± 48	81 ± 8	86 ± 14
Week 13	125 ± 10	163 ± 30	140 ± 23	88 ± 23*
Week 19	143 ± 15	181 ± 32	137 ± 18	90 ± 13
Week 25	188 ± 31	231 ± 44	245 ± 31	158 ± 35
Alanine aminotransferase (IU/L)				
Week 25	25 ± 3	28 ± 3	32 ± 2**	47 ± 4**
Sorbitol dehydrogenase (IU/L)				
Week 25	17 ± 3	17 ± 2	19 ± 2	16 ± 1
Total osteocalcin (ng/mL)				
Week 7	293.6 ± 19.4	287.5 ± 21.2	282.1 ± 34.7	316.7 ± 23.5
Week 13	197.9 ± 22.6	202.3 ± 15.4	184.4 ± 19.4	234.2 ± 14.5
Week 19	158.1 ± 18.3	184.8 ± 13.2	166.7 ± 24.7	210.1 ± 16.0
Week 25	107.9 ± 18.6	97.1 ± 7.1	96.0 ± 16.2	148.8 ± 15.1
Parathyroid hormone (ng/mL)				
Week 7	0.995 ± 0.150[b]	1.156 ± 0.176	1.092 ± 0.182	1.023 ± 0.146
Week 13	1.506 ± 0.203	1.734 ± 0.194	1.925 ± 0.306	1.767 ± 0.212
Week 19	1.406 ± 0.232	1.994 ± 0.353	1.845 ± 0.418	1.673 ± 0.223
Week 25	1.471 ± 0.189[b]	1.628 ± 0.220	1.818 ± 0.224	2.301 ± 0.212*
Urinalysis				
n				
Week 7	10	10	10	10
Week 13	10	10	10	10
Week 19	10	10	10	10
Week 25	10	9	10	9
Volume (mL)				
Week 7	8.2 ± 1.2	8.5 ± 1.0	5.4 ± 0.8	3.4 ± 0.3**
Week 13	6.4 ± 0.7	6.5 ± 0.6	4.1 ± 0.8*	2.9 ± 0.5**
Week 19	7.7 ± 1.2	8.1 ± 1.4	5.0 ± 0.8	3.4 ± 0.5**
Week 25	8.2 ± 1.5	9.1 ± 1.5	5.8 ± 0.9	3.7 ± 0.5**
Deoxypyridinoline/creatinine (nmol/mg)				
Week 7	1.620 ± 0.128	1.240 ± 0.129	1.940 ± 0.229	2.300 ± 0.182*
Week 13	0.580 ± 0.039	0.430 ± 0.037**	0.540 ± 0.034	0.570 ± 0.042
Week 19	0.450 ± 0.017	0.360 ± 0.016*	0.440 ± 0.016	0.520 ± 0.020
Week 25	0.340 ± 0.043	0.222 ± 0.022	0.340 ± 0.027	0.411 ± 0.026

*Significantly different ($P \leq 0.05$) from the control group by Dunn's or Shirley's test.
**$P \leq 0.01$.
[a]Data are presented as mean ± standard error. Statistical tests were performed on unrounded data.
[b]n = 9.

Serum and hepatic vitamin concentrations were measured in Group B rats (Table 5 and Table C-1). Exposure concentration-dependent decreases were observed in serum vitamin A concentrations starting at week 13 in the male rats. The decreases reached statistical significance at weeks 13 (27%), 19 (26%), and 26 (29%) in 9% males and at weeks 13 (15%) and 26 (16%) in 3% males. Females were less affected with significant decreases observed in the 9% group at weeks 19 (18%) and 26 (21%). Exposure concentration-dependent decreases were also observed in serum vitamin E concentrations in male rats at all time points. The decreases were statistically significant at all time points in 3% (33% to 42%) and 9% males (79% to 82%) and in 1% males at week 13 (17%), with the 9% group measuring between 18% to 21% that of control values throughout the study. Females were less affected with significant decreases in serum vitamin E levels observed in the 9% group (approximately 60%) only (all time points). Hepatic vitamin E concentrations were significantly decreased at week 26 in 3% and 9% males (48% and 87%, respectively) and 9% females (80%). In the 9% group, levels of hepatic vitamin E measured only 13% and 20% of control values in the males and females, respectively. Serum concentrations of 1,25 $(OH)_2$ vitamin D were significantly increased in 9% males (105% to 142%) and females (100% to 180%) at weeks 7, 19, and 26 compared to the control groups. Results of plasma hepatic vitamin K concentrations in Group C rats are not discussed or presented, as many samples were below the level of quantification.

Table 5. Serum and Hepatic Vitamin Concentration Data for Group B Rats in the Six-month Feed Study of Chitosan[a]

	0%	1%	3%	9%
Male				
n				
Week 7	9	10	10	10
Week 13	9	10	10	10
Week 19	9	10	10	10
Week 26	9	10	10	8
Serum vitamin A (µg/mL)				
Week 7	0.532 ± 0.021	0.506 ± 0.033	0.513 ± 0.026	0.453 ± 0.018
Week 13	0.561 ± 0.024	0.499 ± 0.019	0.476 ± 0.022*	0.410 ± 0.009**
Week 19	0.533 ± 0.028	0.506 ± 0.031	0.475 ± 0.019	0.392 ± 0.014**
Week 26	0.476 ± 0.019	0.444 ± 0.024	0.398 ± 0.017**	0.336 ± 0.026**
Serum 1,25 $(OH)_2$ vitamin D (pg/mL)				
Week 7	124.4 ± 19.6	163.3 ± 21.7	183.2 ± 26.9	297.4 ± 41.0**
Week 13	70.1 ± 7.3	57.4 ± 5.3	77.3 ± 4.4	86.1 ± 8.5
Week 19	20.6 ± 2.8	21.7 ± 6.1	22.9 ± 2.2	42.3 ± 3.1**[b]
Week 26	27.7 ± 3.4[c]	28.0 ± 4.3	36.1 ± 4.6[b]	66.9 ± 11.9**
Serum vitamin E (µg/mL)				
Week 7	19.33 ± 1.43	15.38 ± 1.29	12.92 ± 0.48**	4.14 ± 0.23**
Week 13	21.08 ± 1.61	17.45 ± 1.06*	12.27 ± 0.86**	4.33 ± 0.27**

	0%	1%	3%	9%
Week 19	20.59 ± 1.61	16.19 ± 0.96	12.86 ± 0.42**	4.07 ± 0.32**
Week 26	19.66 ± 1.66	17.35 ± 1.37	12.35 ± 0.61**	3.59 ± 0.65**
Liver vitamin E (µg/g)				
Week 26	66.8 ± 16.2	55.0 ± 6.8	34.6 ± 2.2**	8.5 ± 0.8**
Female				
n				
Week 7	10	10	10	10
Week 13	10	10	10	10
Week 19	10	10	10	10
Week 26	10	10	9	10
Serum vitamin A (µg/mL)				
Week 7	0.272 ± 0.011	0.253 ± 0.007	0.260 ± 0.012	0.266 ± 0.012
Week 13	0.308 ± 0.020	0.295 ± 0.011	0.309 ± 0.019	0.281 ± 0.018
Week 19	0.283 ± 0.014	0.271 ± 0.015	0.291 ± 0.012	0.231 ± 0.010*
Week 26	0.316 ± 0.015	0.302 ± 0.014	0.294 ± 0.018	0.249 ± 0.010**
Serum 1,25 $(OH)_2$ vitamin D (pg/mL)				
Week 7	104.0 ± 15.1	96.7 ± 10.9	111.0 ± 8.7	208.1 ± 18.2**
Week 13	60.6 ± 7.5	60.7 ± 7.9	69.3 ± 11.0	110.1 ± 16.9
Week 19	11.6 ± 1.6	12.6 ± 1.7	15.8 ± 1.4	31.4 ± 3.2**
Week 26	19.2 ± 2.2	20.7 ± 4.2	28.6 ± 6.5	53.7 ± 5.8**
Serum vitamin E (µg/mL)				
Week 7	18.65 ± 0.71	20.08 ± 0.87	18.38 ± 0.85	6.99 ± 0.58**
Week 13	19.81 ± 1.41	20.85 ± 1.06	20.19 ± 1.20	7.48 ± 0.38**
Week 19	21.02 ± 1.76	19.74 ± 1.75	19.86 ± 1.08	7.37 ± 0.57**
Week 26	20.94 ± 1.56	23.43 ± 1.66	22.23 ± 1.75	7.28 ± 0.64**
Liver vitamin E (µg/g)				
Week 26	84.5 ± 8.9	97.1 ± 10.1	82.0 ± 11.8	17.2 ± 3.2**

*Significantly different ($P \leq 0.05$) from the control group by Dunn's or Shirley's test.
**Significantly different ($P \leq 0.01$) from the control group by Shirley's test.
[a]Data are presented as mean ± standard error. Statistical tests were performed on unrounded data.
[b]n = 9.
[c]n = 7.

Digestive parameters were calculated for Group C rats and are listed in Table 6. Compared to the control groups, percent fat digested was significantly decreased at week 6 in 9% males (28%) and females (14%), during week 12 in 3% and 9% males (8% and 33%, respectively), during week 18 in 9% males (20%) and females (10%), and during week 24 in all exposed groups of males and females (up to 32%). Calcium absorption was significantly increased in 9% females during weeks 12 (55%) and 24 (154%). Fecal weight was significantly increased in 3% and 9% males (up to 170%) and females (up to 126%) during each collection period and in 1% females

during weeks 12, 18, and 24 (18% to 29%). Fecal moisture was significantly increased in 9% males and females at all time points (10% to 15%), in 3% males (4%) at week 6, and in 3% females (7%) at weeks 12 and 18.

Male rats did not display any changes in testis or epididymis weights or sperm parameters, indicating that chitosan did not exhibit the potential to be a reproductive toxicant in male rats (Table E-1).

Table 6. Digestive Data for Group C Rats in the Six-month Feed Study of Chitosan[a]

	0%	1%	3%	9%
Male				
n				
Weeks 6–7	10	10	10	10
Weeks 12–13	10	10	10	10
Weeks 18–19	10	10	10	9
Weeks 24–25	10	10	10	10
Fat digested (%)				
Weeks 6–7	97.04 ± 0.40	97.55 ± 0.22	94.37 ± 0.84	69.55 ± 3.01**
Weeks 12–13	94.79 ± 0.46	93.36 ± 0.83	87.08 ± 0.68**	63.50 ± 2.40**
Weeks 18–19	97.56 ± 0.58	98.48 ± 0.19	95.87 ± 0.70	77.59 ± 1.83**
Weeks 24–25	97.01 ± 0.19	95.61 ± 0.32**	92.14 ± 0.87**	66.18 ± 3.24**
Calcium absorbed (%)				
Weeks 6–7	31.69 ± 1.84	34.57 ± 4.05	27.54 ± 1.83	33.01 ± 1.59
Weeks 12–13	19.81 ± 3.36	14.73 ± 0.76	18.42 ± 3.25	28.01 ± 2.69
Weeks 18–19	13.33 ± 4.33	18.42 ± 5.43	3.64 ± 2.62	11.11 ± 1.35
Weeks 24–25	2.93 ± 1.54	5.14 ± 1.08	0.70 ± 1.57	9.46 ± 1.88
Fecal weight (g)				
Weeks 6–7	21.42 ± 0.68	21.01 ± 1.93	31.33 ± 0.90**	52.39 ± 2.85**
Weeks 12–13	24.32 ± 1.68	27.70 ± 1.37	32.84 ± 1.73**	47.59 ± 4.30**
Weeks 18–19	23.11 ± 1.25	22.67 ± 1.85	33.30 ± 1.72**	62.38 ± 3.67**[b]
Weeks 24–25	26.43 ± 1.12	25.75 ± 0.73	37.17 ± 1.11**	56.35 ± 3.45**
Fecal moisture (%)				
Weeks 6–7	45.0 ± 0.5	42.0 ± 1.6	46.8 ± 0.4*	51.0 ± 0.8**
Weeks 12–13	46.8 ± 2.0	49.0 ± 0.8	48.8 ± 0.6	53.6 ± 0.8**
Weeks 18–19	47.7 ± 1.1	45.3 ± 1.8	49.1 ± 0.7	54.8 ± 1.5**[b]
Weeks 24–25	47.2 ± 0.6	45.7 ± 0.5	49.3 ± 0.7	53.1 ± 0.8**

	0%	1%	3%	9%
Female				
n				
Weeks 6–7	10	10	10	9
Weeks 12–13	10	10	10	10
Weeks 18–19	10	10	10	10
Weeks 24–25	8	9	10	10
Fat digested (%)				
Weeks 6–7	96.47 ± 0.49	95.53 ± 1.30	95.46 ± 0.66	83.23 ± 2.69**
Weeks 12–13	97.12 ± 1.58	98.54 ± 0.99	97.27 ± 1.16	91.95 ± 2.70
Weeks 18–19	99.17 ± 0.18	97.52 ± 0.50	97.15 ± 1.24	89.61 ± 2.53**
Weeks 24–25	98.66 ± 0.08	97.68 ± 0.39**	96.79 ± 0.49**	86.73 ± 1.55**
Calcium absorbed (%)				
Weeks 6–7	31.44 ± 2.35	24.42 ± 2.54	24.36 ± 2.50	32.29 ± 1.69
Weeks 12–13	14.84 ± 1.76	17.03 ± 3.11	17.96 ± 1.22	23.02 ± 2.39*
Weeks 18–19	8.96 ± 3.00	9.78 ± 1.98	0.47 ± 3.37	13.07 ± 1.65
Weeks 24–25	5.65 ± 2.84	9.23 ± 2.74	8.25 ± 1.59	14.50 ± 1.40*
Fecal weight (g)				
Weeks 6–7	14.37 ± 0.91	15.76 ± 0.60	19.85 ± 1.64**	32.61 ± 1.67**[b]
Weeks 12–13	15.37 ± 0.60	18.41 ± 1.28*	21.11 ± 1.07**	30.83 ± 2.78**
Weeks 18–19	16.30 ± 0.86	19.23 ± 0.97*	25.21 ± 1.42**	36.58 ± 2.41**
Weeks 24–25	16.01 ± 0.92[b]	20.66 ± 1.14**	24.85 ± 1.19**	35.78 ± 2.27**
Fecal moisture (%)				
Weeks 6–7	45.3 ± 1.1	45.3 ± 0.4	47.3 ± 0.8	50.0 ± 0.9**[b]
Weeks 12–13	45.9 ± 0.7	47.5 ± 1.0	49.3 ± 0.5**	52.7 ± 1.0**
Weeks 18–19	46.1 ± 1.1	47.2 ± 0.4	49.5 ± 0.9**	53.0 ± 0.7**
Weeks 24–25	47.2 ± 0.6[b]	48.4 ± 1.4	49.2 ± 0.6	52.6 ± 0.9**

*Significantly different ($P \leq 0.05$) from the control group by Shirley's test.
**$P \leq 0.01$.
[a]Data are presented as mean ± standard error. Statistical tests were performed on unrounded data.
[b]n = 10.

Bone parameters in Groups A and B rats were generally unaffected by chitosan exposure (Table C-2). Bone moisture was significantly increased, relative to the control group, in 9% females (7%).

The absolute and relative liver weights of Group A 9% males and females were significantly less (22% and 21% lower, respectively) than those of the respective control groups (Table 7 and Table D-1). The absolute and relative thymus weights of Group A 3% and 9% males and 9% females were significantly less than those of the controls (Table D-1).

There was a significant decrease in the incidence of periportal fatty change of the liver in Group A female rats in the 9% group compared to the control group and decreases in 1% and 3% females that resulted in a negative trend (Table 7 and Table A-2). In male rats, there were decreases in the incidences of periportal fatty change in the 1% and 9% groups, and the severities were decreased in the 3% and 9% groups (Table 7 and Table A-1). Fatty change was characterized by hepatocytes with clear vacuoles (lipid), mostly located within the periportal region of the liver (zone 1) (Figure 3).

Table 7. Liver Parameter Data for Group A Rats in the Six-month Feed Study of Chitosan

	0%	1%	3%	9%
Male				
n[a]	10	10	10	10
Necropsy body wt	669 ± 20	702 ± 21	687 ± 23	612 ± 17
Liver weight[b]				
Absolute	25.19 ± 0.87	24.87 ± 1.35	23.74 ± 1.51	19.53 ± 0.71[##]
Relative	37.662 ± 0.731	35.321 ± 1.179	34.345 ± 1.411[#]	31.933 ± 0.817[##]
Periportal, Fatty Change[c]	6 (1.7)[d]	3 (1.7)	6 (1.3)	3 (1.0)
Female				
n	10	10	10	10
Necropsy body wt	338 ± 11	335 ± 13	328 ± 11	301 ± 13
Liver weight				
Absolute	12.54 ± 0.82	12.47 ± 0.39	11.85 ± 0.29	9.85 ± 0.20[##]
Relative	36.900 ± 1.502	37.341 ± 0.444	36.346 ± 0.904	33.036 ± 0.910[#]
Periportal, Fatty Change	7 (1.1)	4 (1.0)	4 (1.0)	0**

[#]Significantly different (P ≤ 0.05) from the control group by Williams' or Dunnett's test.
[##]Significantly different (P ≤ 0.01) from the control group by Williams' test.
**Significantly different (P ≤ 0.01) from the control group by the Fisher exact test.
[a]Number of animals with liver weighed and with liver examined microscopically.
[b]Liver weights (absolute weights) and body weights are given in grams; Liver-weight-to-body-weight ratios (relative weights) are given as mg liver weight/g body weight (mean ± standard error).
[c]Number of animals with lesion.
[d]Average severity grade of lesions in affected animals: 1 = minimal, 2 = mild, 3 = moderate, 4 = marked.

Hepatocytes contained large, well-defined, single round vacuoles (macrovesicular) within each cell that displaced the nuclei and cytoplasm to the cell periphery (Figure 4) and can be compared with a liver lacking fatty change (Figure 5).

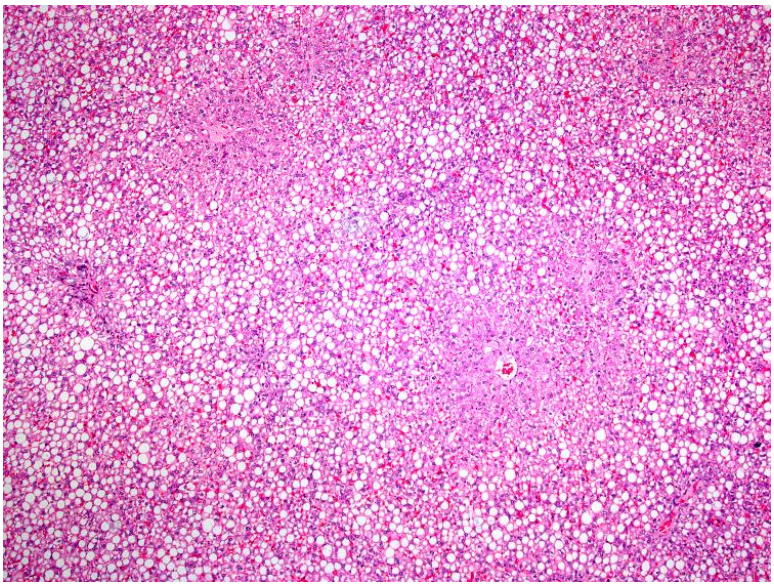

Figure 3. Section of the Liver from a Control Male Sprague Dawley Rat from the Six-month Feed Study of Chitosan with a Moderate Degree of Fatty Change (H&E)

There is a predominant periportal distribution of affected hepatocytes.

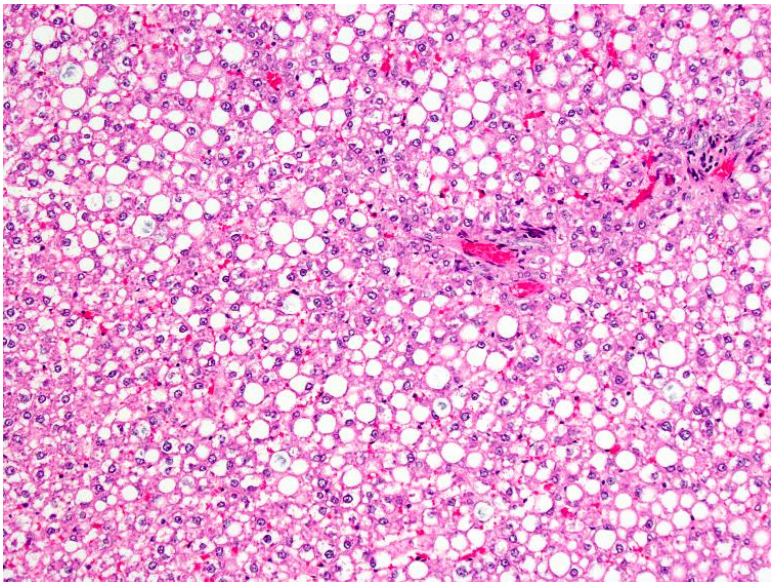

Figure 4. Higher Magnification of Figure 3 (H&E)

The fatty change is characterized by round, discrete vacuoles within hepatocytes that displace the nuclei and cytoplasm to the periphery.

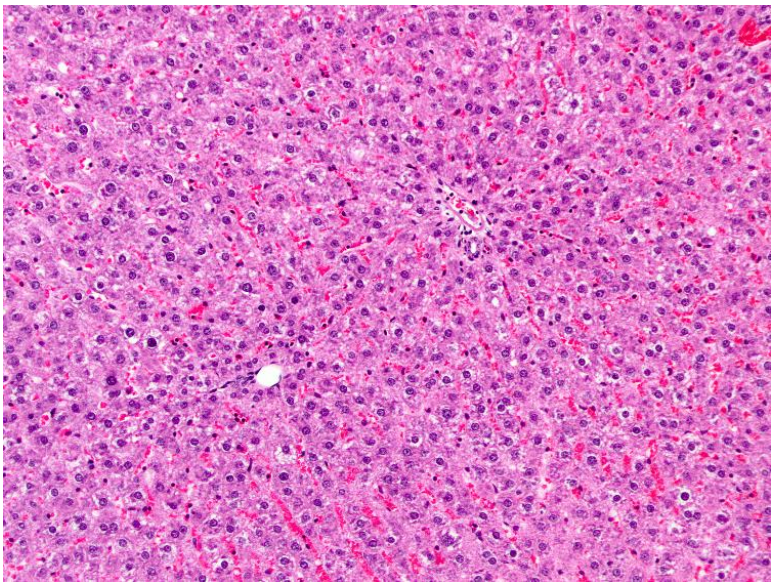

Figure 5. Section of the Liver with a Lack of Fatty Change from a Male Sprague Dawley Rat Exposed to 9% Chitosan in Feed for Six Months (H&E)

There is some minimal vacuolization within many hepatocytes. The vacuoles lack distinct round borders and the nuclei are centrally located, consistent with glycogen accumulation.

Discussion

Human exposure to chitosan occurs primarily through consumption of dietary supplements, as chitosan is marketed as a fiber-like supplement to increase satiation and promote weight loss through inhibition of fat absorption[16]. The acute toxicity of chitosan has previously been examined in human studies (12 days or up to 8 weeks) evaluating the effectiveness of chitosan as a weight-loss supplement, and the results from these studies demonstrated no observable toxicity following oral administration of chitosan[32-34]. However, there is indication of serum vitamin and bone mineral depletion following consumption of chitosan in rats[26]. Therefore, NTP conducted 6-month feed studies to evaluate the effects of dietary chitosan on bone metabolism, fat-soluble vitamin levels, and dietary fat and calcium absorption, as well as general toxicity in Charles River Sprague Dawley rats.

Feed concentrations of 1%, 3%, and 9% chitosan, which resulted in average daily doses of approximately 450, 1,500, and 5,200 mg chitosan/kg body weight per day to males and 650, 1,800, and 6,000 mg/kg per day to females, were selected based on existing data from animal studies[24; 26]. The 9% concentration is higher than the typical 5% NTP concentration limit, but the 9% diet was considered to be nutritionally adequate. The AIN-93M feed was selected for this study over the NTP-2000 feed based on the high levels of fat-soluble vitamins and higher total fat content found in the NTP-2000 feed. The NTP-2000 feed contains almost double the amount of required fat-soluble vitamins and has a higher fat content (7% to 8%) than the AIN-93M feed (4%)[41; 42]. One of the primary rationales for this chitosan study was the potential for decreases in fat-soluble vitamin concentrations, and therefore utilizing a diet with lower levels of preexisting vitamins and a lower fat content was ideal to avoid confounding potential results.

The animals used in this study were split into three groups, the core group, Group A, and two special study groups, Groups B and C. Different parameters were evaluated in each group, which, while allowing for the collection of extensive endpoints, meant that only 10 animals were examined per endpoint instead of 30, as there was no crossover of analyses between the groups.

Multiple endpoints were evaluated at multiple time points (6, 12, 18, and 24 weeks) in Group C rats to determine effects on fat absorption. Treatment-related decreases in percentage fat digestion of 20% to 33% in males and 5% to 14% in females relative to control, were consistently observed in the 9% group with effects also noted in males in the 3% group (decreases of 2% to 8%). Stronger responses were observed in males relative to females. Additionally, fecal weight was significantly increased in 1% females at weeks 12, 18, and 24 (19%, 18%, and 29%, respectively), and in 3% (35% to 56%) and 9% (96% to 170%) males and females relative to controls at all time points. These data suggest that consumption of chitosan reduced the absorption of fat in the feed, resulting in increased fecal weight due to fat being excreted. Similar results have been observed in other studies. Deuchi et al.[55] reported that rats fed deacetylated chitosan had decreased fat digestion; as the degree of deacetylation increased, fat digestibility decreased. The chitosan used by Deuchi et al.[55] was 70% to 90% deacetylated, which is a level very similar to the chitosan (86.5% deacetylated) used in the current study. Gallaher et al.[12] demonstrated that male Wistar rats exposed to 10% chitosan in AIN-93 feed had increased fecal fat excretion and dry fecal weight and decreased cholesterol absorption relative to control rats, similar to what was observed in the current study.

Due to the high percentage of chitosan in the feed of the 9% group, it is possible that the observed decreases in percentage fat digested were due to bulk chitosan in the feces confounding the amount of fat actually being excreted. Misrepresented fecal weights would alter the calculated amount of fat excreted in the feces, which would subsequently affect the calculation of percentage fat digested. The observed increases in fecal weight could also be attributed to an increase in the percentage fecal moisture, which was significantly increased in both males and females in the 3% and 9% groups. In Group A, there were decreases, albeit not significant, in mean body weights of 9% males and females (decreases of 9% and 11%, respectively), but overall there were no significant changes in the body weights of rats exposed to chitosan; the mean body weights of exposed animals were similar to those of control animals. Considering the large decrease in percent fat digested, combined with the significant increase in fecal weight observed in 9% males and females, it would be expected that mean body weights would significantly decrease due to more fat being excreted than digested. The slight mean body weight decrease observed in this study could be due in part to excretion of bulk chitosan, but regardless, the magnitude of increase in fecal fat excretion as well as the decrease in hepatic periportal fatty change still indicates a treatment-related response.

Consistent significant decreases in cholesterol levels were observed in 9% male and female rats; triglycerides levels were also affected but not as consistently as cholesterol. Decreases in cholesterol were consistent with many other studies and not an unexpected finding, as chitosan is well known to have a cholesterol lowering effect in rats[14; 56-59]. The mechanism by which chitosan lowers cholesterol is still controversial, but recent studies indicate that chitosan, acting as a weak anion exchange resin, reduces cholesterol by causing a decrease in its absorption in the small intestine and by inducing increases in bile acid excretion[11-13]. With bile acid excretion, plasma or liver cholesterol is utilized to maintain the bile acid pool[12]. Alternatively, the cholesterol lowering effects of chitosan may be related to an increase in viscosity of intestinal contents, which entrap fat and prevent lipolysis, or this mechanism may be in addition to chitosan's ability to bind bile acids[13-15].

Along with an inhibition in dietary fat absorption and decreases in serum lipids there were also treatment-related decreases in the levels of fat-soluble vitamins A and E. Serum and liver vitamin E levels were substantially affected, being 62% to 87% lower in the 9% males and females. These findings are similar to those of Deuchi et al.[26] where decreases in serum and liver vitamin E levels were observed after 14 days of consuming a 5% chitosan feed. In this same study, liver vitamin A levels were decreased, but vitamin A serum levels were unchanged. Bile and lipids are needed for the absorption of dietary vitamins A and E, as both must be incorporated into intestinal micelles for their absorption[60]. Thus, it is highly plausible that the decrease in dietary fat absorption, including cholesterol, led to the decreases in serum and liver concentrations of these vitamins. It is also possible that, by some unknown mechanism, chitosan may enhance vitamin A or E requirements in the peripheral tissues.

There were no histologic changes associated with the observed decreases in vitamin levels; however, the decreases were significant enough to suggest nutritional inadequacies. The long-term effects of vitamin A and vitamin E deficiencies are well-known[60-63], and it is unknown what deficiency-related effects would have been observed had these decreased levels been maintained for a longer period of time. When circulating levels of vitamin E, specifically α-tocopherol, are depleted, tissue damage can occur. Vitamin E depletion in humans has subsequently been correlated with anemia, disruption of normal growth, decreased responses to infection, and

pregnancy concerns[62]. Vitamin A is essential in numerous biological processes and pathways, including growth, vision development, immune function, and metabolism. Severe vitamin A deficiency (VAD) results in disruption of normal tissue function and is associated with childhood blindness, anemia, and depressed responses to infection; VAD during a severe infection may result in death[61-63]. While the long-term effects of vitamin deficiency in rodents are not as well understood, the available literature on human deficiencies suggests that the decreases in vitamin A and E observed in this study may be detrimental over time.

In contrast to decreases in vitamins A and E, 1,25 $(OH)_2$ vitamin D (bioactive vitamin D) levels were significantly elevated in 9% male and female rats. Vitamin D's main function is to help maintain normal calcium and phosphorus levels by regulating the intestinal absorption of these minerals from the diet. In addition to the increased 1,25 $(OH)_2$ vitamin D levels, significant decreases in serum phosphorus were also seen in male and female rats. Although intestinal absorption of phosphorus was not measured in this study, chitosan has been observed by others to cause a significant reduction in intestinal phosphorus absorption[64]. Low phosphorus concentrations stimulate 1,25 $(OH)_2$ vitamin D production by the kidney, therefore the increased levels of 1,25 $(OH)_2$ vitamin D observed in this study may be the result of the low phosphorus levels. Increased levels of 1,25 $(OH)_2$ vitamin D can cause an increase in intestinal absorption of calcium regardless of serum calcium levels. Significant elevation in intestinal absorption of calcium was observed sporadically in the female rats, but serum calcium levels were relatively stable. This effect is most likely due to a loss of calcium through the urine, which has been observed in other chitosan feed studies[64; 65] and is known to occur in cases of hypophosphatemia-induced elevations in 1,25 $(OH)_2$ vitamin D due to Fanconi's syndrome[66]. The reported urinary calcium loss in chitosan feed studies may be compensatory or directly induced by the chitosan.

Significant decreases in urine volume were observed in various male and female groups, but most consistently in the 9% group where decreases of 40% to 58% of the control group volume were observed. As the urine volumes decreased, urine creatinine concentrations were seen to increase significantly. This is consistent with proper renal function. The most likely cause of the decrease in urine volume is decreased consumption of water, although water consumption was not measured, so this cannot be certain. However, the mild increases in urea nitrogen in the 9% male and female rats at 25 weeks (the only time point measured) supports decreased water consumption (i.e., mild dehydration). Water retention in the intestine may have contributed to the decreases in urine volume, as fecal moisture was mildly increased in some of the treatment groups, although it is highly unlikely this would be the primary cause and no diarrhea was observed.

There was a significant decrease in the occurrence of periportal fatty change, or lipid accumulation, in the livers of 9% females relative to the controls, and this negative trend was maintained in both 1% and 3% females, although not significantly. In male rats, the incidences of periportal fatty change were decreased in both 1% and 9% groups and the severities were decreased in both the 3% and 9% groups. The decrease in lipid accumulation was inconsistent between male and female rats in the 9% exposure groups, as a more severe decrease was observed in the 9% female rats (100% lower) compared to the 9% male rats (50% lower) relative to the respective controls. The morphologic features observed during this study (periportal hepatocytes with large, single, well-defined intracytoplasmic vacuoles displacing the nucleus), were consistent with the intracytoplasmic lipid accumulation that is associated with fatty change[67]. During normal function, fatty acids circulate between the liver and adipose tissue,

which maintains a balance of triglycerides between the two locations. When this balance becomes skewed, hepatic fatty acids can accumulate as small vacuoles in the hepatocytes and progress over time into larger globules[67; 68].

Lipid accumulation in the liver can occur via multiple mechanisms, including 1) increased synthesis of fatty acids, 2) increased uptake of fatty acids from adipose tissue and/or the diet, 3) improper removal of fatty acids from the liver, or 4) decreased oxidation of fatty acids[69]. Diet and nutritional status can also influence lipid accumulation[68; 70]. Singh et al.[71] demonstrated that albino rats administered vitamin A orally for 2 days had increased hepatic lipid accumulation. In the present study, there were treatment-related decreases in hepatic vitamin A and E in both male and female rats, which could have contributed to the loss of periportal lipid accumulation observed in the animals fed 9% chitosan. Lipid accumulation in the liver can also occur due to imbalanced uptake of lipids from the blood and secretion of lipoproteins from the hepatocytes[72]. In this chitosan study, the fatty change (lipid accumulation) observed was periportal, or in Zone 1. Zone 1 is closest to the incoming vasculature and receives the majority of oxygenated blood, and Zone 1 hepatocytes are generally resistant to the effects of nutritional deficiencies[73]. Therefore, the decrease in fatty change observed in rats fed 9% chitosan could be an adaptive response to the vitamin and mineral depletion noted in this study.

The incidences and severities of fatty change in both male and female control animals was particularly high (6/10, males; 7/10, females; average severity 1.7 and 1.1, respectively), suggesting that the Charles River Sprague Dawley rats used in this study may have a normally high level of hepatic periportal lipid accumulation. Figure 3, Figure 4, and Figure 5, included in this report, are well representative of the observations made in this study, as the increased severity of periportal fatty change in control animals was a strong response.

Absolute and relative liver weights of male and female rats were significantly decreased in animals fed 9% chitosan relative to control animals. As described above, there were decreases in the incidence of periportal fatty change in all exposed animals, particularly in the female rats fed 9% chitosan. The decrease in liver weights observed in the 9% animals could be due to the loss of fat accumulation in the livers, which would alter the weight of the organs.

The absolute and relative thymus weights of 3% and 9% males and 9% females were also significantly decreased relative to those of control groups. The thymus is extremely sensitive to toxic compounds and similar stressors, and alterations in thymus weight can be an indicator of apoptosis and organ atrophy in response to a toxic insult. Nutritional status can cause a decrease in thymus weight, in particular vitamin, mineral, and fatty acid deficiencies[74]. In the current study, male and female rats fed 9% chitosan had depleted levels of serum vitamin A and E, liver vitamin E, and serum cholesterol and triglycerides, indicating nutritional inadequacies. The observations from this chitosan study, combined with what is known about the thymus, suggest that exposure to chitosan may have induced reductions in thymus weight secondary to nutritional deficiencies.

Results of this study did not support chitosan as a cause of bone resorption. Significant elevation of parathyroid hormone levels occurred occasionally and inconsistently, while calcium levels were relatively stable. Calcium was mildly, but significantly, decreased at only two time points in male groups by no more than 4%. Additionally, serum total osteocalcin and urinary deoxypyridinoline level, both biomarkers of bone turnover, while occasionally significantly

elevated, lacked any consistent increases over time or between sexes. In fact, deoxypyridinoline was significantly decreased at some time points. Lastly, bone calcium, bone length, and the histology findings of this study did not support calcium loss from the bone.

Although bone parameters were unaffected by chitosan exposure, a limitation of this study may be that the time frame of the study was not extensive enough to adequately evaluate bone loss. Rats are generally not considered skeletally mature until 10 months of age, and the long bones in rats can continue to grow until 30 months of age, making it difficult to observe any loss of bone before that point[75]. In a study of female Charles River Sprague Dawley rats, Wronski et al.[76] observed closed growth plates in the tibias of 15-month-old animals. In a separate study, Fukuda and Iida[77] noted that natural decreases in bone mineral density did not begin until 15 months of age in female Wistar rats. Also, standard osteoporosis studies using rat models commonly utilize ovariectomized animals, which mimics the conditions of menopause and generally increases rates of bone remodeling and bone loss. Ovariectomized SHRSP rats fed 10% chitosan alongside a low calcium diet exhibited decreased bone mineral density and increased femur stiffness[64]. Following ovariectomy, bone loss in the femurs, specifically the femoral neck, is still not observed until a minimum of 30 days postprocedure[75]. Therefore, given the time frame of the study there was reduced likelihood of observing any osteologic changes possibly induced by chitosan exposure.

There were no treatment-related clinical findings in the core, Group A animals, but there were instances of seizures in Groups B and C animals. Thirteen animals from Groups B and C (two 1%, one 3%, and ten 9%) were observed with seizures either during or after the 18-week blood collection. Seizures were not noted at any other time point. Similarly, there was no treatment-related mortality in the Group A animals, but five animals from Groups B and C died, often after seizures, near the time of blood collection. Cause of death was undetermined for these animals. While there was no clear connection between chitosan treatment and the incidence of seizures, there was an exposure concentration-related increase in the occurrence of seizures. Therefore, it is possible that chitosan exposure may have induced the increased rate of seizures observed in this study.

Under the conditions of the 6-month feed study of chitosan, male and female rats fed 3% and 9% chitosan in the diet had significantly decreased levels of serum vitamin A and serum and hepatic vitamin E and increased levels of serum 1,25 $(OH)_2$ vitamin D. Consumption of high levels of chitosan decreased percentage fat digestion and increased fecal weight and moisture, as well as reduced levels of phosphorous, cholesterol, and triglycerides. Female rats exposed to 9% chitosan also had significant liver weight and histologic changes. Based on the above results, the lowest-observed-effect level for chitosan exposure was 1% (approximately equivalent to 450 mg/kg) in male and 9% (approximately equivalent to 6,000 mg/kg) in female rats.

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Appendix A. Summary of Lesions in Rats in the Six-month Feed Study of Chitosan

Tables

Table A-1. Summary of the Incidence of Nonneoplastic Lesions in Group A Male Rats in the Six-month Feed Study of Chitosan A-2
Table A-2. Summary of the Incidence of Neoplasms and Nonneoplastic Lesions in Group A Female Rats in the Six-month Feed Study of Chitosan A-4

Table A-1. Summary of the Incidence of Nonneoplastic Lesions in Group A Male Rats in the Six-month Feed Study of Chitosan[a]

	0%	1%	3%	9%
Disposition Summary				
Animals initially in study	10	10	10	10
Survivors				
Terminal euthanasia	10	10	10	10
Animals examined microscopically	10	10	10	10
Alimentary System				
Liver	(10)	(10)	(10)	(10)
Degeneration, cystic	0	0	0	1 (10%)
Hematopoietic cell proliferation	2 (20%)	3 (30%)	3 (30%)	6 (60%)
Inflammation, chronic active	10 (100%)	10 (100%)	10 (100%)	9 (90%)
Periportal, fatty change	6 (60%)	3 (30%)	6 (60%)	3 (30%)
Pancreas	(10)	(0)	(0)	(10)
Basophilic focus	1 (10%)	–	–	0
Inflammation	2 (20%)	–	–	1 (10%)
Stomach, forestomach	(10)	(0)	(0)	(10)
Epithelium, hyperplasia	3 (30%)	–	–	1 (10%)
Cardiovascular System				
Blood vessel	(10)	(0)	(0)	(10)
Inflammation	0	–	–	1 (10%)
Heart	(10)	(0)	(0)	(10)
Cardiomyopathy	5 (50%)	–	–	3 (30%)
Mineralization	0	–	–	1 (10%)
Endocrine System				
Adrenal cortex	(10)	(1)	(0)	(10)
Vacuolization cytoplasmic	0	0	–	1 (10%)
Parathyroid gland	(10)	(10)	(10)	(10)
Hyperplasia	1 (10%)	0	0	0
Pituitary gland	(10)	(0)	(0)	(10)
Cyst	1 (10%)	–	–	0
Thyroid gland	(10)	(0)	(0)	(10)
C-cell, hyperplasia	0	–	–	1 (10%)
General Body System				
None	–	–	–	–

	0%	1%	3%	9%
Genital System				
Preputial gland	(10)	(0)	(0)	(10)
Inflammation	0	–	–	1 (10%)
Inflammation, chronic active	0	–	–	2 (20%)
Prostate	(10)	(10)	(10)	(10)
Inflammation	8 (80%)	9 (90%)	10 (100%)	10 (100%)
Testes	(10)	(0)	(0)	(10)
Mineralization	0	–	–	1 (10%)
Hematopoietic System				
Lymph node, mandibular	(10)	(0)	(0)	(10)
Infiltration cellular, plasma cell	1 (10%)	–	–	2 (20%)
Spleen	(10)	(0)	(0)	(10)
Hematopoietic cell proliferation	5 (50%)	–	–	2 (20%)
Thymus	(10)	(0)	(0)	(10)
Atrophy	1 (10%)	–	–	0
Integumentary System				
Skin	(10)	(0)	(0)	(10)
Hemorrhage	0	–	–	1 (10%)
Mineralization	0	–	–	1 (10%)
Ulcer	0	–	–	1 (10%)
Musculoskeletal System				
Skeletal muscle	(0)	(0)	(0)	(1)
Inflammation, granulomatous	–	–	–	1 (100%)
Nervous System				
None	–	–	–	–
Respiratory System				
Lung	(10)	(0)	(0)	(10)
Hemorrhage	2 (20%)	–	–	0
Inflammation, chronic active	2 (20%)	–	–	4 (40%)
Nose	(10)	(0)	(0)	(10)
Inflammation	1 (10%)	–	–	0
Goblet cell, hyperplasia	0	–	–	1 (10%)
Special Senses System	–	–	–	
Eye	(10)	(1)	(0)	(10)
Choroid, fibrosis	0	1 (100%)	–	0
Lens, cataract	0	1 (100%)	–	0

	0%	1%	3%	9%
Harderian gland	(10)	(0)	(0)	(10)
Hyperplasia	0	–	–	1 (10%)
Infiltration cellular, lymphocyte	2 (20%)	–	–	1 (10%)
Urinary System				
Kidney	(10)	(10)	(10)	(10)
Infarct	0	0	1 (10%)	0
Mineralization	2 (20%)	4 (40%)	3 (30%)	5 (50%)
Nephropathy	9 (90%)	9 (90%)	9 (90%)	9 (90%)
Cortex, cyst	1 (10%)	0	0	0
Pelvis, dilatation	2 (20%)	0	1 (10%)	0
Pelvis, inflammation	1 (10%)	0	0	0
Urinary bladder	(10)	(0)	(0)	(10)
Transitional epithelium, hyperplasia	0	–	–	1 (10%)

[a]Number of animals examined microscopically at the site and the number of animals with lesion.

Table A-2. Summary of the Incidence of Neoplasms and Nonneoplastic Lesions in Group A Female Rats in the Six-month Feed Study of Chitosan[a]

	0%	1%	3%	9%
Disposition Summary				
Animals initially in study	10	10	10	10
Survivors				
Terminal euthanasia	10	10	10	10
Animals examined microscopically	10	10	10	10
Alimentary System				
Liver	(10)	(10)	(10)	(10)
Hematopoietic cell proliferation	1 (10%)	1 (10%)	2 (20%)	1 (10%)
Inflammation, chronic active	9 (90%)	9 (90%)	9 (90%)	10 (100%)
Periportal, fatty change	7 (70%)	4 (40%)	4 (40%)	0
Pancreas	(10)	(0)	(0)	(10)
Atrophy	0	–	–	1 (10%)
Inflammation	1 (10%)	–	–	0
Inflammation, chronic active	0	–	–	1 (10%)
Cardiovascular System				
Heart	(10)	(0)	(0)	(10)
Cardiomyopathy	1 (10%)	–	–	0
Endocrine System				
Pituitary gland	(10)	(0)	(0)	(10)

	0%	1%	3%	9%
Rathke's cleft, hyperplasia	1 (10%)	–	–	0
General Body System				
None	–	–	–	–
Genital System				
Clitoral gland	(10)	(0)	(0)	(10)
Inflammation, chronic active	2 (20%)	–	–	0
Hematopoietic System				
Spleen	(10)	(0)	(0)	(10)
Hematopoietic cell proliferation	1 (10%)	–	–	0
Thymus	(10)	(0)	(0)	(10)
Atrophy	1 (10%)	–	–	0
Integumentary System				
Mammary gland	(10)	(0)	(0)	(10)
Adenoma	0	–	–	1 (10%)
Musculoskeletal System				
None	–	–	–	–
Nervous System				
Brain	(10)	(0)	(0)	(10)
Developmental malformation	1 (10%)	–	–	0
Respiratory System				
Lung	(10)	(0)	(0)	(10)
Mineralization	0	–	–	1 (10%)
Alveolar epithelium, hyperplasia	0	–	–	1 (10%)
Alveolus, infiltration cellular, histiocyte	2 (20%)	–	–	0
Artery, mineralization	1 (10%)	–	–	1 (10%)
Nose	(10)	(0)	(0)	(10)
Goblet cell, hyperplasia	1 (10%)	–	–	0
Special Senses System				
Harderian gland	(10)	(0)	(0)	(10)
Infiltration cellular, lymphocyte	1 (10%)	–	–	1 (10%)
Urinary System				
Kidney	(10)	(10)	(10)	(10)
Mineralization	8 (80%)	8 (80%)	5 (50%)	6 (60%)
Nephropathy	5 (50%)	6 (60%)	5 (50%)	0

[a]Number of animals examined microscopically at the site and the number of animals with lesion.

Appendix B. Clinical Pathology Results

Tables

Table B-1. Hematology, Clinical Chemistry, and Urinalysis Data for Group C Rats in the Six-month Feed Study of Chitosan.....B-2

Table B-1. Hematology, Clinical Chemistry, and Urinalysis Data for Group C Rats in the Six-month Feed Study of Chitosan[a]

	0%	1%	3%	9%
Male				
Hematology				
n	10	10	10	10
Hematocrit (auto) (%)				
Week 25	45.5 ± 0.4	47.1 ± 0.5	46.3 ± 0.4	47.4 ± 0.6*
Hematocrit (manual) (%)				
Week 25	47.2 ± 0.5[b]	48.2 ± 0.5	47.6 ± 0.5	48.9 ± 0.6
Hemoglobin (g/dL)				
Week 25	14.9 ± 0.2	15.4 ± 0.2	15.2 ± 0.1	15.7 ± 0.2**
Erythrocytes (10^6/µL)				
Week 25	8.44 ± 0.08	8.59 ± 0.12	8.43 ± 0.08	8.45 ± 0.12
Reticulocytes (10^3/µL)				
Week 25	186.0 ± 14.3	138.4 ± 6.3**	157.7 ± 7.2	139.3 ± 9.1**
Mean cell volume (fL)				
Week 25	53.9 ± 0.4	54.9 ± 0.6	54.9 ± 0.2	56.1 ± 0.6*
Mean cell hemoglobin (pg)				
Week 25	17.6 ± 0.2	18.0 ± 0.2	18.0 ± 0.1	18.6 ± 0.2**
Mean cell hemoglobin concentration (g/dL)				
Week 25	32.7 ± 0.2	32.7 ± 0.1	32.9 ± 0.2	33.2 ± 0.2
Platelets (10^3/µL)				
Week 25	916 ± 52	824 ± 26	921 ± 19	973 ± 36
Leukocytes (10^3/µL)				
Week 25	10.62 ± 0.98	9.39 ± 0.94	7.38 ± 0.69	9.54 ± 0.91
Segmented neutrophils (10^3/µL)				
Week 25	2.04 ± 0.38	1.48 ± 0.24	1.06 ± 0.12	1.76 ± 0.39
Lymphocytes (10^3/µL)				
Week 25	8.02 ± 0.64	7.42 ± 0.74	6.01 ± 0.62	7.44 ± 0.65
Monocytes (10^3/µL)				
Week 25	0.31 ± 0.05	0.32 ± 0.05	0.20 ± 0.02	0.19 ± 0.03
Basophils (10^3/µL)				
Week 25	0.04 ± 0.01	0.04 ± 0.01	0.02 ± 0.00	0.03 ± 0.01
Eosinophils (10^3/µL)				
Week 25	0.21 ± 0.05	0.15 ± 0.03	0.09 ± 0.01*	0.11 ± 0.03

	0%	1%	3%	9%
Clinical Chemistry				
n	10	10	10	10
Urea nitrogen (mg/dL)				
Week 25	12.4 ± 0.6	12.1 ± 0.5	12.7 ± 0.5	15.3 ± 0.9**
Creatinine (mg/dL)				
Week 25	0.62 ± 0.01	0.64 ± 0.02	0.62 ± 0.01	0.64 ± 0.02
Calcium (mg/dL)				
Week 13	12.6 ± 0.1	12.5 ± 0.1	12.3 ± 0.2	12.4 ± 0.2
Week 19	12.5 ± 0.1	12.3 ± 0.2	12.3 ± 0.1	12.0 ± 0.1*
Week 25	12.1 ± 0.1	12.1 ± 0.2	12.0 ± 0.1	11.6 ± 0.1*
Phosphorus (mg/dL)				
Week 13	8.4 ± 0.3	8.1 ± 0.3	7.2 ± 0.3**	7.4 ± 0.4*
Week 19	8.2 ± 0.4	7.7 ± 0.2	7.4 ± 0.3	6.7 ± 0.2**
Week 25	6.9 ± 0.3	6.8 ± 0.2	6.7 ± 0.1	5.8 ± 0.3**
Total protein (g/dL)				
Week 25	7.4 ± 0.1	7.2 ± 0.1	7.3 ± 0.1	6.9 ± 0.1*
Albumin (g/dL)				
Week 19	4.8 ± 0.1	4.6 ± 0.1	4.7 ± 0.1	4.5 ± 0.0*
Week 25	4.8 ± 0.1	4.7 ± 0.1	4.8 ± 0.1	4.6 ± 0.0
Cholesterol (mg/dL)				
Week 7	82 ± 5	75 ± 8	80 ± 6	53 ± 3**
Week 13	95 ± 7	84 ± 8	90 ± 7	53 ± 2**
Week 19	101 ± 6	87 ± 10	94 ± 8	59 ± 4**
Week 25	95 ± 6	81 ± 8	90 ± 6	49 ± 4**
Triglycerides (mg/dL)				
Week 7	202 ± 28	234 ± 43	226 ± 30	88 ± 15*
Week 13	198 ± 33	202 ± 38	195 ± 24	86 ± 8**
Week 19	180 ± 26	218 ± 43	210 ± 29	95 ± 13*
Week 25	173 ± 18	207 ± 30	218 ± 24	109 ± 13
Alanine aminotransferase (IU/L)				
Week 25	28 ± 3	29 ± 2	29 ± 1	57 ± 2**
Alkaline phosphatase (IU/L)				
Week 7	134 ± 7	134 ± 7	138 ± 8	137 ± 16
Week 13	100 ± 6	95 ± 6	102 ± 6	82 ± 5
Week 19	91 ± 11	87 ± 7	84 ± 4	72 ± 7
Week 25	85 ± 7	83 ± 7	82 ± 5	64 ± 5*

	0%	1%	3%	9%
Creatine kinase (IU/L)				
Week 25	192 ± 29	205 ± 27	233 ± 23	245 ± 20
Sorbitol dehydrogenase (IU/L)				
Week 25	17 ± 3	17 ± 2	15 ± 1	14 ± 1
Bile acids (µmol/L)				
Week 25	9.6 ± 2.3	6.4 ± 2.7	2.4 ± 0.2**	4.3 ± 0.8
Total osteocalcin (ng/mL)				
Week 7	445.7 ± 17.2	439.8 ± 15.8	441.8 ± 18.2	520.4 ± 22.6
Week 13	306.2 ± 13.0	289.7 ± 28.6	245.4 ± 37.9	372.6 ± 23.4
Week 19	239.4 ± 12.4	225.7 ± 10.6	181.6 ± 26.8	269.2 ± 20.9
Week 25	158.3 ± 10.0	168.1 ± 11.6	145.9 ± 22.7	218.3 ± 14.6*
Parathyroid hormone (ng/mL)				
Week 7	1.882 ± 0.137	1.643 ± 0.449	1.838 ± 0.348	1.521 ± 0.368
Week 13	2.343 ± 0.350	2.763 ± 0.479	3.215 ± 0.537	2.433 ± 0.222
Week 19	1.879 ± 0.186	3.101 ± 0.475	2.710 ± 0.365	3.679 ± 0.361**
Week 25	2.668 ± 0.475	2.924 ± 0.276	3.981 ± 0.349	2.848 ± 0.506
Urinalysis				
n				
Week 7	10	9	10	10
Week 13	10	10	10	10
Week 19	10	10	10	10
Week 25	10	10	10	10
Creatinine (mg/dL)				
Week 7	192.5 ± 15.1	227.2 ± 30.7	269.4 ± 33.6	254.9 ± 37.2
Week 13	249.4 ± 25.1	360.7 ± 19.5*	350.3 ± 22.5*	334.0 ± 35.8
Week 19	204.3 ± 20.4	394.2 ± 32.5**	345.1 ± 26.0**	302.5 ± 26.6
Week 25	254.1 ± 27.4	374.8 ± 25.6*	345.9 ± 27.1	325.4 ± 36.0
Volume (mL)				
Week 7	8.3 ± 0.8	7.5 ± 1.5	6.4 ± 0.8	5.0 ± 1.1*
Week 13	7.9 ± 1.0	4.6 ± 0.3**	5.1 ± 0.4*	4.5 ± 0.5**
Week 19	10.7 ± 1.6	4.0 ± 0.4**	5.3 ± 0.7*	5.6 ± 0.6
Week 25	8.6 ± 1.2	5.4 ± 0.6*	6.1 ± 0.8*	5.1 ± 0.6**
Deoxypyridinoline (nmol/L)				
Week 7	3,396.0 ± 268.0	4,210.0 ± 643.0	4,917.0 ± 826.0	4,754.0 ± 761.0
Week 13	2,185.1 ± 188.9	3,197.3 ± 148.3*	3,233.8 ± 218.0*	3,129.1 ± 296.5*
Week 19	1,084.9 ± 158.9	2,209.6 ± 246.3**	1,963.0 ± 200.5*	1,994.9 ± 214.3*

	0%	1%	3%	9%
Week 25	1,083.5 ± 145.9	1,699.3 ± 139.6*	1,658.3 ± 136.7*	1,750.8 ± 167.6*
Deoxypyridinoline/creatinine (nmol/mg)				
Week 7	1.810 ± 0.135	1.889 ± 0.148	1.810 ± 0.159	1.920 ± 0.160
Week 13	0.910 ± 0.035	0.890 ± 0.031	0.930 ± 0.040	0.960 ± 0.078
Week 19	0.530 ± 0.050	0.550 ± 0.034	0.570 ± 0.042	0.660 ± 0.048
Week 25	0.430 ± 0.030	0.470 ± 0.030	0.480 ± 0.020	0.550 ± 0.027**
Female				
Hematology				
n	10	9	10	10
Hematocrit (auto) (%)				
Week 25	45.5 ± 1.0	44.9 ± 0.9	44.5 ± 0.8	45.2 ± 0.9
Hematocrit (manual) (%)				
Week 25	47.4 ± 1.1	46.9 ± 1.0	46.5 ± 0.8	46.6 ± 0.9
Hemoglobin (g/dL)				
Week 25	15.2 ± 0.4	15.0 ± 0.3	15.0 ± 0.3	15.1 ± 0.3
Erythrocytes (10^6/µL)				
Week 25	8.16 ± 0.19	8.17 ± 0.18	8.01 ± 0.11	8.10 ± 0.15
Reticulocytes (10^3/µL)				
Week 25	135.2 ± 14.6	109.2 ± 6.1	109.6 ± 7.7	129.5 ± 14.6
Mean cell volume (fL)				
Week 25	55.8 ± 0.6	55.0 ± 0.3	55.6 ± 0.3	55.8 ± 0.8
Mean cell hemoglobin (pg)				
Week 25	18.7 ± 0.2	18.4 ± 0.1	18.7 ± 0.1	18.7 ± 0.3
Mean cell hemoglobin concentration (g/dL)				
Week 25	33.5 ± 0.1	33.4 ± 0.2	33.6 ± 0.2	33.4 ± 0.2
Platelets (10^3/µL)				
Week 25	791 ± 43	798 ± 40	848 ± 38	1,024 ± 51**
Leukocytes (10^3/µL)				
Week 25	6.62 ± 0.92	3.66 ± 0.49*	5.72 ± 0.87	4.92 ± 0.58
Segmented neutrophils (10^3/µL)				
Week 25	1.15 ± 0.24	0.53 ± 0.10*	0.67 ± 0.11	0.67 ± 0.11
Lymphocytes (10^3/µL)				
Week 25	5.09 ± 0.79	2.93 ± 0.41	4.78 ± 0.77	4.06 ± 0.49
Monocytes (10^3/µL)				
Week 25	0.24 ± 0.04	0.13 ± 0.02	0.18 ± 0.03	0.11 ± 0.02*

	0%	1%	3%	9%
Basophils (10^3/μL)				
Week 25	0.02 ± 0.00	0.01 ± 0.00*	0.02 ± 0.01	0.01 ± 0.00
Eosinophils (10^3/μL)				
Week 25	0.12 ± 0.02	0.06 ± 0.01	0.08 ± 0.01	0.07 ± 0.02
Clinical Chemistry				
n				
Week 7	10	10	10	10
Week 13	10	10	10	10
Week 19	10	10	10	10
Week 25	10	9	10	10
Urea nitrogen (mg/dL)				
Week 25	14.2 ± 1.4	14.1 ± 0.7	15.2 ± 0.7	16.3 ± 0.7*
Creatinine (mg/dL)				
Week 25	0.65 ± 0.02	0.68 ± 0.01	0.70 ± 0.01	0.69 ± 0.02
Calcium (mg/dL)				
Week 13	12.9 ± 0.2	13.1 ± 0.1	12.7 ± 0.2	12.5 ± 0.2
Week 19	12.9 ± 0.1	13.1 ± 0.2	12.8 ± 0.1	12.5 ± 0.1
Week 25	12.7 ± 0.3	12.8 ± 0.1	12.7 ± 0.2	12.3 ± 0.2
Phosphorus (mg/dL)				
Week 13	8.1 ± 0.5	7.4 ± 0.4	6.5 ± 0.4**	6.8 ± 0.3*
Week 19	8.4 ± 0.4	8.2 ± 0.5	8.1 ± 0.3	7.4 ± 0.5
Week 25	6.8 ± 0.2	6.4 ± 0.2	6.2 ± 0.3*	5.5 ± 0.3**
Total protein (g/dL)				
Week 25	8.2 ± 0.2	9.0 ± 0.1**	8.6 ± 0.2	8.4 ± 0.2
Albumin (g/dL)				
Week 19	5.9 ± 0.2	6.2 ± 0.1	5.9 ± 0.2	5.7 ± 0.1
Week 25	5.8 ± 0.2	6.5 ± 0.2*	6.2 ± 0.1	6.2 ± 0.1
Cholesterol (mg/dL)				
Week 7	80 ± 6	81 ± 8	67 ± 4	59 ± 4**
Week 13	92 ± 8	86 ± 7	73 ± 5	58 ± 4**
Week 19	107 ± 7	105 ± 9	91 ± 8	67 ± 5**
Week 25	94 ± 7	108 ± 5	96 ± 8	63 ± 4**
Triglycerides (mg/dL)				
Week 7	88 ± 12	130 ± 48	81 ± 8	86 ± 14
Week 13	125 ± 10	163 ± 30	140 ± 23	88 ± 23*
Week 19	143 ± 15	181 ± 32	137 ± 18	90 ± 13

	0%	1%	3%	9%
Week 25	188 ± 31	231 ± 44	245 ± 31	158 ± 35
Alanine aminotransferase (IU/L)				
Week 25	25 ± 3	28 ± 3	32 ± 2**	47 ± 4**
Alkaline phosphatase (IU/L)				
Week 7	102 ± 7	99 ± 5	99 ± 7	95 ± 10
Week 13	57 ± 4	63 ± 4	71 ± 7	59 ± 5
Week 19	49 ± 5	53 ± 3	55 ± 6	46 ± 6
Week 25	46 ± 4	44 ± 2	51 ± 6	44 ± 7
Creatine kinase (IU/L)				
Week 25	258 ± 44	193 ± 46	210 ± 50	225 ± 26
Sorbitol dehydrogenase (IU/L)				
Week 25	17 ± 3	17 ± 2	19 ± 2	16 ± 1
Bile acids (µmol/L)				
Week 25	10.7 ± 1.8	8.2 ± 1.1	32.0 ± 14.1	10.8 ± 1.1
Total osteocalcin (ng/mL)				
Week 7	293.6 ± 19.4	287.5 ± 21.2	282.1 ± 34.7	316.7 ± 23.5
Week 13	197.9 ± 22.6	202.3 ± 15.4	184.4 ± 19.4	234.2 ± 14.5
Week 19	158.1 ± 18.3	184.8 ± 13.2	166.7 ± 24.7	210.1 ± 16.0
Week 25	107.9 ± 18.6	97.1 ± 7.1	96.0 ± 16.2	148.8 ± 15.1
Parathyroid hormone (ng/mL)				
Week 7	0.995 ± 0.150[b]	1.156 ± 0.176	1.092 ± 0.182	1.023 ± 0.146
Week 13	1.506 ± 0.203	1.734 ± 0.194	1.925 ± 0.306	1.767 ± 0.212
Week 19	1.406 ± 0.232	1.994 ± 0.353	1.845 ± 0.418	1.673 ± 0.223
Week 25	1.471 ± 0.189[b]	1.628 ± 0.220	1.818 ± 0.224	2.301 ± 0.212*
Urinalysis				
n				
Week 7	10	10	10	10
Week 13	10	10	10	10
Week 19	10	10	10	10
Week 25	10	9	10	9
Creatinine (mg/dL)				
Week 7	98.2 ± 14.7	107.1 ± 12.3	206.3 ± 55.2*	192.0 ± 8.3**
Week 13	144.7 ± 14.8	139.5 ± 15.9	247.5 ± 30.9*	241.6 ± 29.0**
Week 19	142.0 ± 19.7	137.7 ± 19.4	196.3 ± 23.6	230.3 ± 19.2**
Week 25	179.8 ± 59.7	120.3 ± 24.1	184.5 ± 20.5	217.9 ± 23.4*

	0%	1%	3%	9%
Volume (mL)				
Week 7	8.2 ± 1.2	8.5 ± 1.0	5.4 ± 0.8	3.4 ± 0.3**
Week 13	6.4 ± 0.7	6.5 ± 0.6	4.1 ± 0.8*	2.9 ± 0.5**
Week 19	7.7 ± 1.2	8.1 ± 1.4	5.0 ± 0.8	3.4 ± 0.5**
Week 25	8.2 ± 1.5	9.1 ± 1.5	5.8 ± 0.9	3.7 ± 0.5**
Deoxypyridinoline (nmol/L)				
Week 7	1,622.0 ± 328.0	1,378.0 ± 295.0	4,130.0 ± 1,109.0*	4,423.0 ± 355.0**
Week 13	875.5 ± 129.6	587.0 ± 68.1	1,364.0 ± 215.9	1,421.6 ± 267.0
Week 19	666.3 ± 106.9	487.7 ± 68.5	894.9 ± 122.1	1,212.3 ± 107.4**
Week 25	565.7 ± 178.2	250.4 ± 47.1	625.1 ± 83.7	891.5 ± 114.1*
Deoxypyridinoline/creatinine (nmol/mg)				
Week 7	1.620 ± 0.128	1.240 ± 0.129	1.940 ± 0.229	2.300 ± 0.182*
Week 13	0.580 ± 0.039	0.430 ± 0.037**	0.540 ± 0.034	0.570 ± 0.042
Week 19	0.450 ± 0.017	0.360 ± 0.016*	0.440 ± 0.016	0.520 ± 0.020
Week 25	0.340 ± 0.043	0.222 ± 0.022	0.340 ± 0.027	0.411 ± 0.026

*Significantly different ($P \leq 0.05$) from the control group by Dunn's or Shirley's test.
**$P \leq 0.01$.
[a]Data are presented as mean ± standard error. Statistical tests were performed on unrounded data.
[b]n = 9.

Appendix C. Vitamin Concentration and Bone Parameter Results

Tables

Table C-1. Serum and Hepatic Vitamin Concentration Data for Group B Rats in the Six-month Feed Study of Chitosan C-2
Table C-2. Bone Data for Groups A and B Rats in the Six-month Feed Study of Chitosan C-3

Table C-1. Serum and Hepatic Vitamin Concentration Data for Group B Rats in the Six-month Feed Study of Chitosan[a]

	0%	1%	3%	9%
Male				
n				
Week 7	9	10	10	10
Week 13	9	10	10	10
Week 19	9	10	10	10
Week 26	9	10	10	8
Serum vitamin A (µg/mL)				
Week 7	0.532 ± 0.021	0.506 ± 0.033	0.513 ± 0.026	0.453 ± 0.018
Week 13	0.561 ± 0.024	0.499 ± 0.019	0.476 ± 0.022*	0.410 ± 0.009**
Week 19	0.533 ± 0.028	0.506 ± 0.031	0.475 ± 0.019	0.392 ± 0.014**
Week 26	0.476 ± 0.019	0.444 ± 0.024	0.398 ± 0.017**	0.336 ± 0.026**
Serum 1,25 $(OH)_2$ vitamin D (pg/mL)				
Week 7	124.4 ± 19.6	163.3 ± 21.7	183.2 ± 26.9	297.4 ± 41.0**
Week 13	70.1 ± 7.3	57.4 ± 5.3	77.3 ± 4.4	86.1 ± 8.5
Week 19	20.6 ± 2.8	21.7 ± 6.1	22.9 ± 2.2	42.3 ± 3.1**[b]
Week 26	27.7 ± 3.4[c]	28.0 ± 4.3	36.1 ± 4.6[b]	66.9 ± 11.9**
Serum vitamin E (µg/mL)				
Week 7	19.33 ± 1.43	15.38 ± 1.29	12.92 ± 0.48**	4.14 ± 0.23**
Week 13	21.08 ± 1.61	17.45 ± 1.06*	12.27 ± 0.86**	4.33 ± 0.27**
Week 19	20.59 ± 1.61	16.19 ± 0.96	12.86 ± 0.42**	4.07 ± 0.32**
Week 26	19.66 ± 1.66	17.35 ± 1.37	12.35 ± 0.61**	3.59 ± 0.65**
Liver vitamin A (µg/g)				
Week 26	57.4 ± 17.6	29.9 ± 2.5	39.6 ± 3.1	31.4 ± 3.7
Liver vitamin E (µg/g)				
Week 26	66.8 ± 16.2	55.0 ± 6.8	34.6 ± 2.2**	8.5 ± 0.8**
Female				
n				
Week 7	10	10	10	10
Week 13	10	10	10	10
Week 19	10	10	10	10
Week 26	10	10	9	10
Serum vitamin A (µg/mL)				
Week 7	0.272 ± 0.011	0.253 ± 0.007	0.260 ± 0.012	0.266 ± 0.012
Week 13	0.308 ± 0.020	0.295 ± 0.011	0.309 ± 0.019	0.281 ± 0.018
Week 19	0.283 ± 0.014	0.271 ± 0.015	0.291 ± 0.012	0.231 ± 0.010*
Week 26	0.316 ± 0.015	0.302 ± 0.014	0.294 ± 0.018	0.249 ± 0.010**

	0%	1%	3%	9%
Serum 1,25 $(OH)_2$ vitamin D (pg/mL)				
Week 7	104.0 ± 15.1	96.7 ± 10.9	111.0 ± 8.7	208.1 ± 18.2**
Week 13	60.6 ± 7.5	60.7 ± 7.9	69.3 ± 11.0	110.1 ± 16.9
Week 19	11.6 ± 1.6	12.6 ± 1.7	15.8 ± 1.4	31.4 ± 3.2**
Week 26	19.2 ± 2.2	20.7 ± 4.2	28.6 ± 6.5	53.7 ± 5.8**
Serum vitamin E (µg/mL)				
Week 7	18.65 ± 0.71	20.08 ± 0.87	18.38 ± 0.85	6.99 ± 0.58**
Week 13	19.81 ± 1.41	20.85 ± 1.06	20.19 ± 1.20	7.48 ± 0.38**
Week 19	21.02 ± 1.76	19.74 ± 1.75	19.86 ± 1.08	7.37 ± 0.57**
Week 26	20.94 ± 1.56	23.43 ± 1.66	22.23 ± 1.75	7.28 ± 0.64**
Liver vitamin A (µg/g)				
Week 26	65.2 ± 5.4	58.9 ± 5.0	62.3 ± 6.3	60.3 ± 4.8
Liver vitamin E (µg/g)				
Week 26	84.5 ± 8.9	97.1 ± 10.1	82.0 ± 11.8	17.2 ± 3.2**

*Significantly different ($P \leq 0.05$) from the control group by Dunn's or Shirley's test.
**Significantly different ($P \leq 0.01$) from the control group by Shirley's test.
[a]Data are presented as mean ± standard error. Statistical tests were performed on unrounded data.
[b]n = 9.
[c]n = 7.

Table C-2. Bone Data for Groups A and B Rats in the Six-month Feed Study of Chitosan[a]

	0%	1%	3%	9%
n	10	10	10	10
Male				
Bone calcium (%)	23.79 ± 0.21[b]	23.95 ± 0.22	23.92 ± 0.30	23.74 ± 0.11[c]
Bone ash (%)	45.33 ± 0.79[b]	45.24 ± 0.67	45.83 ± 0.52	43.46 ± 0.62[c]
Bone moisture (%)	29.90 ± 0.49[b]	30.30 ± 0.44	29.72 ± 0.36	31.79 ± 0.62[c]
Left femur length (mm)	43.96 ± 0.34	44.33 ± 0.30	44.10 ± 0.30	43.42 ± 0.37
Left tibia length (mm)	48.00 ± 0.37	48.27 ± 0.36	47.95 ± 0.37	47.57 ± 0.41
Right tibia length (mm)	48.06 ± 0.32	48.41 ± 0.41	47.95 ± 0.33	47.57 ± 0.43
Female				
Bone calcium (%)	24.65 ± 0.17	24.96 ± 0.20	24.77 ± 0.23[b]	24.84 ± 0.12
Bone ash (%)	47.07 ± 0.58	47.14 ± 0.57	47.44 ± 0.46[b]	45.87 ± 0.44
Bone moisture (%)	28.40 ± 0.54	28.45 ± 0.45	28.53 ± 0.49[b]	30.37 ± 0.37**
Left femur length (mm)	36.65 ± 0.21	36.75 ± 0.17	36.73 ± 0.28	36.37 ± 0.26
Left tibia length (mm)	40.56 ± 0.28	40.25 ± 0.23	40.62 ± 0.40	40.10 ± 0.24
Right tibia length (mm)	40.53 ± 0.30	40.42 ± 0.24	40.74 ± 0.42	40.12 ± 0.21

**Significantly different ($P \leq 0.01$) from the control group by Shirley's test.
[a]Data are presented as mean ± standard error. Statistical tests were performed on unrounded data. Bone content data are from Group B rats at week 26 and bone lengths are from Group A rats at week 25.
[b]n = 9.
[c]n = 8.

Appendix D. Organ Weights and Organ-Weight-to-Body-Weight Ratios

Tables

Table D-1. Organ Weights and Organ-Weight-to-Body-Weight Ratios for Group A Rats in the Six-month Feed Study of Chitosan D-2

Table D-1. Organ Weights and Organ-Weight-to-Body-Weight Ratios for Group A Rats in the Six-month Feed Study of Chitosan[a]

	0%	1%	3%	9%
n	10	10	10	10
Male				
Necropsy body wt	669 ± 20	702 ± 21	687 ± 23	612 ± 17
Heart				
Absolute	1.82 ± 0.07	1.81 ± 0.06	1.86 ± 0.08	1.77 ± 0.06
Relative	2.723 ± 0.089	2.589 ± 0.070	2.710 ± 0.091	2.904 ± 0.085
R. Kidney				
Absolute	2.04 ± 0.04	2.04 ± 0.04	2.11 ± 0.06	1.88 ± 0.04*
Relative	3.068 ± 0.088	2.920 ± 0.047	3.093 ± 0.088	3.093 ± 0.094
Liver				
Absolute	25.19 ± 0.87	24.87 ± 1.35	23.74 ± 1.51	19.53 ± 0.71**
Relative	37.662 ± 0.731	35.321 ± 1.179	34.345 ± 1.411*	31.933 ± 0.817**
Lung				
Absolute	2.49 ± 0.11	2.77 ± 0.09	2.62 ± 0.08	2.53 ± 0.14
Relative	3.738 ± 0.163	3.949 ± 0.095	3.841 ± 0.138	4.120 ± 0.160
R. Testis				
Absolute	1.696 ± 0.054	1.778 ± 0.046	1.726 ± 0.062	1.750 ± 0.028
Relative	2.555 ± 0.108	2.546 ± 0.078	2.534 ± 0.107	2.883 ± 0.104
Thymus				
Absolute	0.763 ± 0.045	0.727 ± 0.065	0.606 ± 0.063*	0.489 ± 0.032**
Relative	1.147 ± 0.071	1.030 ± 0.077	0.888 ± 0.091*	0.797 ± 0.045**
Thyroid gland and parathyroid gland				
Absolute	0.033 ± 0.003	0.034 ± 0.002	0.034 ± 0.002	0.031 ± 0.002
Relative	0.049 ± 0.004	0.048 ± 0.003	0.050 ± 0.003	0.051 ± 0.003
Parathyroid gland				
Absolute	0.0012 ± 0.0001	0.0010 ± 0.0001	0.0011 ± 0.0001	0.0011 ± 0.0001
Relative	0.002 ± 0.000	0.001 ± 0.000	0.002 ± 0.000	0.002 ± 0.000
Female				
Necropsy body wt	338 ± 11	335 ± 13	328 ± 11	301 ± 13
Heart				
Absolute	1.14 ± 0.03	1.09 ± 0.02	1.15 ± 0.03	1.03 ± 0.02**
Relative	3.393 ± 0.121	3.295 ± 0.094	3.515 ± 0.100	3.473 ± 0.134
R. Kidney				
Absolute	1.12 ± 0.04	1.10 ± 0.02	1.13 ± 0.03	1.01 ± 0.03

	0%	1%	3%	9%
Relative	3.311 ± 0.085	3.311 ± 0.095	3.465 ± 0.108	3.399 ± 0.104
Liver				
Absolute	12.54 ± 0.82	12.47 ± 0.39	11.85 ± 0.29	9.85 ± 0.20**
Relative	36.900 ± 1.502	37.341 ± 0.444	36.346 ± 0.904	33.036 ± 0.910*
Lung				
Absolute	1.83 ± 0.06	1.80 ± 0.08	1.81 ± 0.05	1.65 ± 0.05
Relative	5.463 ± 0.181	5.396 ± 0.170	5.552 ± 0.202	5.557 ± 0.281
R. Ovary				
Absolute	0.054 ± 0.005	0.049 ± 0.005	0.057 ± 0.005	0.056 ± 0.007
Relative	0.161 ± 0.015	0.147 ± 0.015	0.179 ± 0.021	0.190 ± 0.026
Thymus				
Absolute	0.436 ± 0.033	0.400 ± 0.036	0.383 ± 0.023	0.302 ± 0.021**
Relative	1.284 ± 0.081	1.188 ± 0.083	1.169 ± 0.062	1.000 ± 0.047**
Thyroid gland and parathyroid gland				
Absolute	0.028 ± 0.002	0.027 ± 0.002	0.035 ± 0.002	0.031 ± 0.002
Relative	0.084 ± 0.005	0.082 ± 0.007	0.106 ± 0.007	0.104 ± 0.008
Parathyroid gland				
Absolute	0.0007 ± 0.0001	0.0009 ± 0.0001	0.0008 ± 0.0001	0.0008 ± 0.0001
Relative	0.002 ± 0.000	0.003 ± 0.000*	0.002 ± 0.000	0.003 ± 0.000*
Uterus				
Absolute	0.657 ± 0.052	0.744 ± 0.060	0.714 ± 0.038	0.789 ± 0.096
Relative	1.980 ± 0.186	2.252 ± 0.191	2.184 ± 0.104	2.650 ± 0.329

*Significantly different ($P \leq 0.05$) from the control group by Williams' or Dunnett's test.
**$P \leq 0.01$.
[a]Organ weights (absolute weights) and body weights are given in grams; organ-weight-to-body-weight ratios (relative weights) are given as mg organ weight/g body weight (mean ± standard error).

Appendix E. Reproductive Tissue Evaluations

Tables

Table E-1. Summary of Reproductive Tissue Evaluations for Group A Male Rats in the Six-month Feed Study of Chitosan E-2

Table E-1. Summary of Reproductive Tissue Evaluations for Group A Male Rats in the Six-month Feed Study of Chitosan[a]

	0%	1%	3%	9%
n	10	10	10	10
Weights (g)				
Necropsy body wt	669 ± 20	702 ± 21	687 ± 23	612 ± 17
L. Cauda epididymis	0.2013 ± 0.0073	0.2134 ± 0.0079	0.2281 ± 0.0167	0.2072 ± 0.0103
L. Epididymis	0.6874 ± 0.0184	0.7047 ± 0.0274	0.7398 ± 0.0175	0.6402 ± 0.0165
L. Testis	1.7349 ± 0.0423	1.8209 ± 0.0478	1.7922 ± 0.0619	1.7900 ± 0.0333
Spermatid measurements				
Spermatid heads (10^6/testis)	207.79 ± 18.44	183.39 ± 9.19	238.70 ± 20.45	175.57 ± 8.43
Spermatid heads (10^6/g testis)	120.38 ± 11.23	101.50 ± 5.84	135.54 ± 14.11	98.05 ± 4.29
Epididymal spermatozoal measurements				
Sperm motility (%)	86.0 ± 0.37	86.1 ± 0.46	85.9 ± 0.46	85.8 ± 0.47
Sperm (10^6/cauda epididymis)	169.25 ± 14.82	182.38 ± 8.81	160.75 ± 12.63	157.63 ± 12.41
Sperm (10^6/g cauda epididymis)	833 ± 52	856 ± 33	711 ± 33	760 ± 46

[a]Data are presented as mean ± standard error. Differences from the control group are not significant by Dunnett's test (body and tissue weights) or Dunn's test (spermatid and epididymal spermatozoal measurements).

Appendix F. Chemical Characterization and Dose Formulation Studies

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Table F-2. Preparation and Storage of Dose Formulations in the Six-month Feed Study of Chitosan F-4
Table F-3. Results of Analyses of Dose Formulations Administered to Rats in the Six-month Feed Study of Chitosan F-4

Figures

Figure F-1. Infrared Absorption Spectrum of Chitosan F-5
Figure F-2. Proton Nuclear Magnetic Resonance Spectrum of Chitosan F-5

F.1. Procurement and Characterization of Chitosan

Chitosan was obtained from Vanson HaloSource, Inc. (Redmond, WA), in one lot (02-ASSF-0715), which was used in the 6-month study. Identity, purity, and stability analyses were conducted by the analytical chemistry laboratory at Midwest Research Institute (MRI) (Kansas City, MO) and by the study laboratory at Battelle Columbus Operations (Columbus, OH). Reports on analyses performed in support of the chitosan studies are on file at the National Institute of Environmental Health Sciences.

The test article, an off-white powder, was identified as chitosan by the analytical chemistry laboratory using infrared (IR) and proton nuclear magnetic resonance (NMR) spectroscopy and by the study laboratory using IR spectroscopy. The percentage of deacetylation of the test article, determined by proton NMR, ranged from 85.97% to 87.17%, with an average of 86.5%. All spectra were consistent with the literature spectra[38; 39], and with the Sadtler spectral database. Representative IR and NMR spectra are presented in Figure F-1 and Figure F-2, respectively.

The moisture content for lot 02-ASSF-0715 was determined by the analytical chemistry laboratory using weight loss on drying in a 110°C oven for 24 hours; the inorganic content was determined on the dried test article by ashing at 500°C for 4 hours. Viscosity was determined at approximately 22.5°C using a Brookfield viscometer fitted with an SC4-18/R13 spindle at a speed of 30 rpm. Lot 02-ASSF-0715 was characterized by the analytical chemistry laboratory using gel permeation chromatography (GPC) with refractive index (RI) detection using system A (Table F-1) to find the most abundant molecular weight. Samples were prepared by transferring approximately 75 mg of the test article into a vial, and adding a 25 mL aliquot of diluent; vials were sealed with Teflon®-lined septa and crimp caps, allowed to stand for 2 hours at ambient temperature, swirled by hand, and placed on a rotary shaker for at least 1 hour. Standards containing a total of six molecular weight dextran markers with known peak molecular weights (Mp) (4,400, 21,400, 43,500, 196,000, 277,000, and 3,900,000 Mp) were prepared; approximately 10 mg of each marker (3 mg of 3,900,000 Mp marker) and 10 mL of diluent were pipetted into vials, sealed with Teflon®-lined septa and crimp caps, allowed to stand for a least 2 hours (the 3,900,000 marker was allowed to stand overnight) at ambient temperature to dissolve the standards, then swirled to mix prior to analysis.

For lot 02-ASSF-0715, weight loss on drying indicated 4.50% water, the average inorganic content by ashing was determined to be 2.13%, and viscosity was 81.3 centipoise. GPC/RI indicated one major peak and the determined molecular weight of the bulk chemical ranged from 62,755 to 87,343 daltons (Da). This resulted in an average molecular weight of 81,644 g/mol, or approximately 82 kDa, classifying the test article as a low molecular weight chitosan (LMWCS). A sample of chitosan was submitted to Covance Laboratories, Inc. (Madison, WI), for nutritional and contaminant testing using standard methods. For lot 02-ASSF-0715, levels of organochlorine and organophosphorous pesticides, nitrosamines, and aflatoxins were below the detection limits of the analytical methods. The purity of lot 02-ASSF-0715 was estimated to be approximately 94% based on the analysis of moisture and inorganic content. Taken together, these data indicated that the test article was chitosan.

To ensure stability, the test article was stored in sealed amber glass vials at room temperature. Reanalysis of the test article was performed during the study by the study laboratory using GPC/RI by system B, and no degradation of the test article was detected.

F.2. Preparation and Analysis of Dose Formulations

The dose formulations were prepared approximately monthly by mixing chitosan with feed (Table F-2). Dose formulations were stored in lined plastic buckets sealed with lids and stored at −30°C to −15°C for up to 42 days.

Homogeneity studies of approximately 0.5% and 9% formulations (5,046 and 90,049 µg/g, respectively) and stability studies of an approximately 0.5% (5,046 µg/g) formulation were performed by the analytical chemistry laboratory using GPC/RI by system C (Table F-1). Two peaks were attributed to chitosan with retention times of approximately 6.9 minutes and 12.1 minutes, respectively. Chitosan quantitation was based on the larger polymeric components of the first peak only because vehicle components co-eluted with the later oligomeric peak. Homogeneity studies of 1% and 9% dose formulations (10 mg/g and 90 mg/g in feed, respectively) were performed by the study laboratory using GPC/RI by system B. Homogeneity was confirmed, and stability was confirmed for at least 42 days for dose formulations stored in lined plastic buckets sealed with lids at temperatures up to room temperature and for at least 7 days under simulated animal room conditions.

Periodic analyses of the dose formulations of chitosan were performed by the study laboratory using GPC/RI by system B. Of the dose formulations analyzed, all nine were within 10% of the target concentrations (Table F-3). Animal room samples of dose formulations were also analyzed; all three were within 10% of the target concentrations.

Table F-1. Gel Permeation Chromatography Systems Used in the Six-month Feed Study of Chitosan[a]

Detection System	Column	Solvent System
System A		
Refractive index	In series: NOVEMA 10,000 Å, 300 mm × 8 mm, 10 µm and NOVEMA 3,000 Å, 50 mm × 8 mm (guard) and NOVEMA 3,000 Å, 300 mm × 8 mm, 10 µm (Polymer Standards Service GmbH, Mainz, Germany)	0.25% Trifluoroacetic acid, isocratic, flow rate 1.0 mL/minute
System B		
Refractive index	In series: BioSep-SEC-S2000 145 Å, 300 mm × 4.6 mm, 5 µm and BioSep-SEC-S3000 290 Å, 300 mm × 4.6 mm, 5 µm (Phenomenex, Torrance, CA)	1% Trifluoroacetic acid, isocratic, flow rate 0.35 mL/minute
System C		
Refractive index	In series: Alltech® Macrosphere 100 Å, 250 mm × 4.6 mm, 7 µm and Alltech® Macrosphere 300 Å, 250 mm × 4.6 mm, 7 µm (Grace, Columbia, MD)	1% Trifluoroacetic acid, isocratic, flow rate 0.5 mL/minute

[a]The liquid chromatographs were manufactured by Waters Corporation (Milford, MA) (System A), Agilent (Palo Alto, CA) (System B), or Perkin Elmer (Boston, MA) (System C).

Table F-2. Preparation and Storage of Dose Formulations in the Six-month Feed Study of Chitosan

Six-month Feed Study
Preparation
The appropriate amounts of chitosan and AIN-93M feed (87 kg for 1% and 3% formulations and 79 kg for the 9% formulation) were weighed in tared stainless steel buckets and layered into a Patterson-Kelly twin-shell blender. The chitosan beaker was rinsed twice with portions of the blank feed, added to the blender, and the formulation was mixed for 15 minutes. The dose formulations were prepared approximately monthly.
Chemical Lot Number
02-ASSF-0715
Maximum Storage Time
42 days
Storage Conditions
Stored in plastic-lined 5 gallon plastic buckets sealed with lids at −30° to −15°C
Study Laboratory
Battelle Columbus Operations (Columbus, OH)

Table F-3. Results of Analyses of Dose Formulations Administered to Rats in the Six-month Feed Study of Chitosan

Date Prepared	Date Analyzed	Target Concentration[a] (mg/g)	Determined Concentration[b] (mg/g)	Difference from Target (%)
August 15, 2006	August 17–18, 2006	10	9.1	−10
		30	27.3	−9
		90	83.5	−7
	October 2–3, 2006[c]	10	9.99	0
		30	30.3	+1
		90	92.4	+3
October 10, 2006	October 11–12, 2006	10	9.5	−5
		30	27.0	−10
		90	94.2	+5
January 2, 2007	January 2–3, 2007	10	10.6	+6
		30	29.5	−2
		90	94.3	+5

[a]10, 30, and 90 mg/g are equivalent to 1%, 3%, and 9% chitosan concentrations, respectively.
[b]Results of duplicate analyses.
[c]Animal room samples.

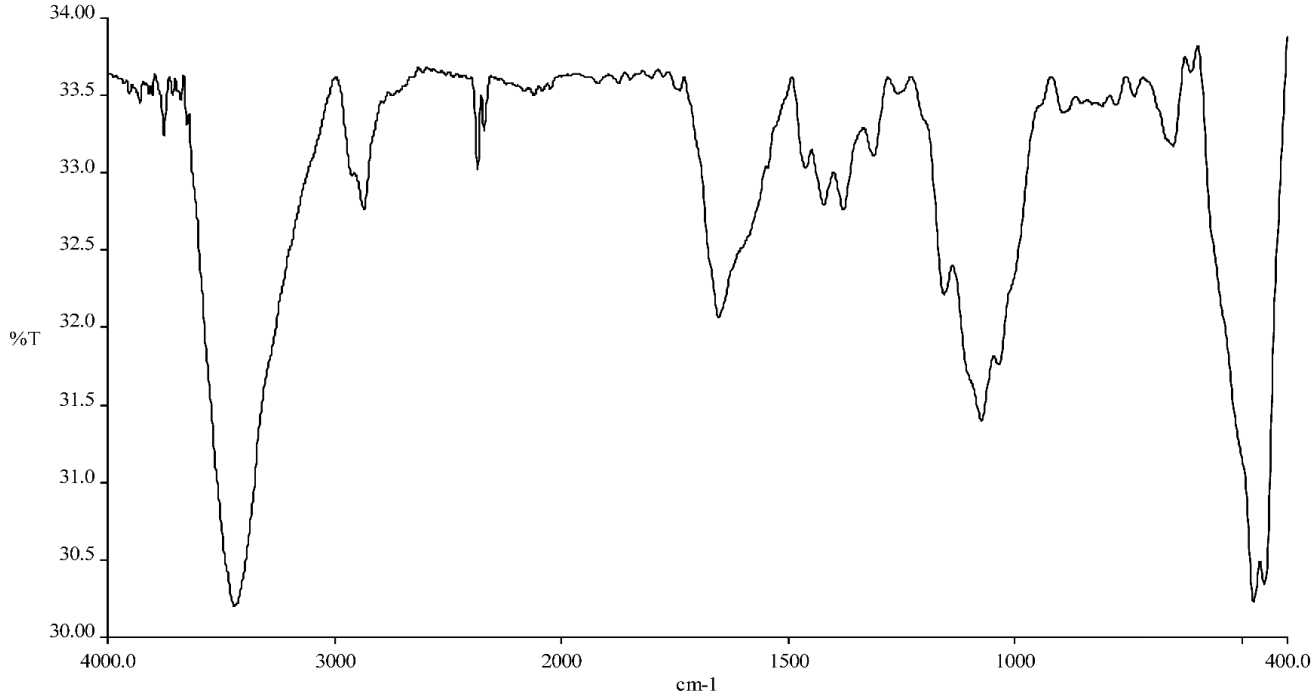

Figure F-1. Infrared Absorption Spectrum of Chitosan

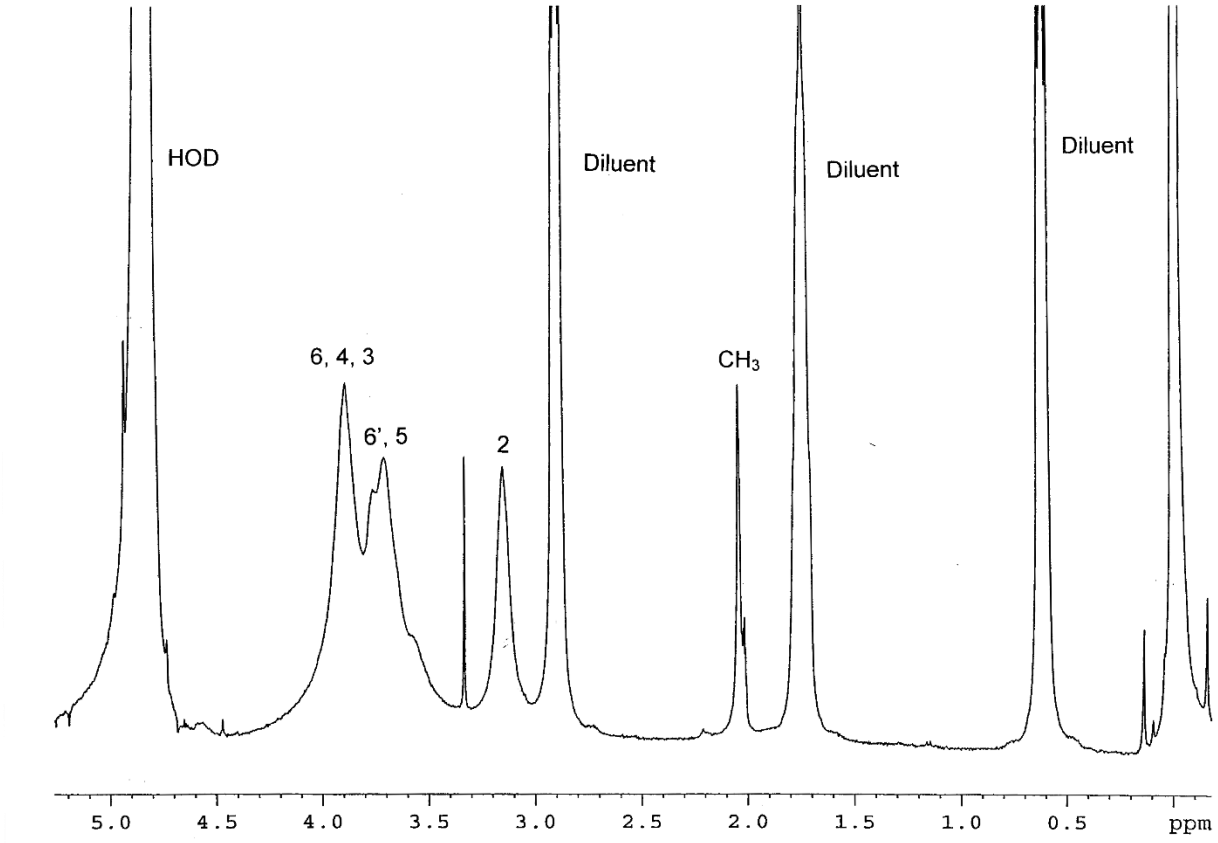

Figure F-2. Proton Nuclear Magnetic Resonance Spectrum of Chitosan

Appendix G. Feed and Compound Consumption in the Six-month Feed Study of Chitosan

Tables

Table G-1. Feed and Compound Consumption by Group A Male Rats in the Six-month Feed Study of Chitosan G-2
Table G-2. Feed and Compound Consumption by Group A Female Rats in the Six-month Feed Study of Chitosan G-3

Table G-1. Feed and Compound Consumption by Group A Male Rats in the Six-month Feed Study of Chitosan

Week	0%		1%			3%			9%		
	Feed[a] (g/day)	Body Weight (g)	Feed (g/day)	Body Weight (g)	Dose[b] (mg/kg)	Feed (g/day)	Body Weight (g)	Dose (mg/kg)	Feed (g/day)	Body Weight (g)	Dose (mg/kg)
1	22.2	238	23.8	243	980	23.6	242	2,929	21.4	243	7,931
2	21.6	297	23.1	308	750	23.0	303	2,278	26.9	265	9,137
3	22.8	346	24.0	359	668	25.4	354	2,156	27.3	307	8,002
4	22.6	388	23.5	404	582	24.9	398	1,877	26.7	350	6,872
5	22.3	421	23.5	438	537	25.8	436	1,774	27.4	388	6,355
6	21.5	446	21.7	465	467	24.6	464	1,591	26.4	413	5,759
7	23.1	475	23.5	493	477	25.7	491	1,570	27.8	442	5,662
8	22.3	496	24.1	513	470	25.2	514	1,471	27.1	464	5,259
9	22.3	514	24.1	535	450	25.1	534	1,411	26.7	483	4,980
10	21.8	529	23.2	554	419	25.1	548	1,373	26.2	498	4,735
11	21.8	543	23.3	570	409	25.5	566	1,353	25.5	511	4,493
12	21.6	554	23.1	585	395	24.5	579	1,270	26.4	521	4,557
13	22.3	563	22.6	598	378	24.8	584	1,274	26.9	527	4,595
14	21.5	578	22.9	612	374	25.7	602	1,280	26.4	544	4,371
15	21.7	587	22.7	622	365	25.5	613	1,249	26.7	557	4,315
16	22.2	597	22.7	631	360	27.0	620	1,306	28.5	565	4,542
17	23.4	607	23.7	645	367	28.0	634	1,325	29.2	575	4,569
18	23.6	614	24.6	657	375	28.4	646	1,320	29.0	584	4,468
19	22.3	624	23.0	667	345	26.6	657	1,214	27.8	595	4,202
20	23.6	633	23.2	677	343	25.4	664	1,148	27.4	600	4,112
21	23.8	643	23.4	689	340	24.8	670	1,110	28.5	606	4,230
22	24.1	653	23.1	700	330	25.7	677	1,139	26.9	612	3,959
23	22.6	665	21.3	707	301	25.7	686	1,125	25.4	615	3,715
24	21.5	666	19.6	704	278	24.9	689	1,084	25.4	612	3,738
25	21.2		20.4			24.7			27.3		
Mean for Weeks											
1–13	22.2	447	23.3	466	537	24.9	462	1,717	26.4	416	6,026
14–24	22.8	624	22.7	665	343	26.2	651	1,209	27.4	588	4,202

[a]Grams of feed consumed per animal per day.
[b]Milligrams of chitosan consumed per kilogram body weight per day.

Table G-2. Feed and Compound Consumption by Group A Female Rats in the Six-month Feed Study of Chitosan

Week	0%		1%			3%			9%		
	Feed[a] (g/day)	Body Weight (g)	Feed (g/day)	Body Weight (g)	Dose[b] (mg/kg)	Feed (g/day)	Body Weight (g)	Dose (mg/kg)	Feed (g/day)	Body Weight (g)	Dose (mg/kg)
1	17.7	175	22.3	173	1,286	17.3	177	2,940	16.9	177	8,606
2	15.1	199	15.4	198	779	15.6	197	2,381	17.6	191	8,298
3	15.8	220	16.2	217	747	15.0	214	2,102	16.9	206	7,371
4	16.2	233	16.7	229	728	15.6	231	2,023	17.3	221	7,044
5	16.0	248	17.4	241	722	15.9	242	1,974	17.3	234	6,649
6	14.7	258	17.5	252	694	14.7	251	1,759	16.4	243	6,067
7	15.9	266	17.9	262	683	15.2	259	1,759	16.7	248	6,069
8	15.9	274	17.3	268	645	15.5	267	1,739	16.7	259	5,810
9	15.9	281	17.7	276	641	15.9	274	1,740	16.7	266	5,656
10	15.9	287	18.2	284	641	15.7	281	1,678	16.6	268	5,577
11	15.2	294	17.4	289	601	15.5	286	1,624	16.2	274	5,329
12	15.8	300	17.5	295	594	15.9	292	1,632	15.7	279	5,071
13	15.3	305	16.1	300	537	16.9	298	1,699	16.2	281	5,192
14	15.3	312	16.8	303	555	16.3	304	1,609	16.5	285	5,218
15	14.7	316	16.2	307	528	16.7	309	1,623	16.8	288	5,258
16	16.2	320	19.1	311	615	17.7	314	1,694	19.2	291	5,940
17	15.9	325	18.2	314	581	16.9	315	1,611	18.0	293	5,537
18	16.4	327	19.5	317	615	17.8	318	1,679	19.1	296	5,803
19	17.8	330	19.6	321	610	18.9	321	1,768	18.6	299	5,607
20	17.3	328	21.7	324	670	18.8	321	1,757	19.2	297	5,819
21	18.2	335	21.1	332	636	19.0	330	1,725	19.1	302	5,688
22	18.5	339	19.7	337	584	19.2	336	1,712	18.9	306	5,554
23	17.4	343	17.5	340	515	17.3	339	1,532	17.7	306	5,201
24	16.1	345	17.2	340	506	15.6	339	1,381	16.7	309	4,863
25	16.4		20.3			17.1			18.8		
Mean for Weeks											
1–13	15.8	257	17.5	253	715	15.7	251	1,927	16.7	242	6,364
14–24	16.7	329	18.8	322	583	17.7	322	1,645	18.2	297	5,499

[a]Grams of feed consumed per animal per day.
[b]Milligrams of chitosan consumed per kilogram body weight per day.

Appendix H. Ingredients and Nutrient Composition in AIN-93M Maintenance Purified Diet

Tables

Table H-1. Ingredients of AIN-93M Maintenance Purified Rodent Diet H-2
Table H-2. Vitamins, Minerals, and Nutrient Composition of AIN-93M Maintenance Purified Rodent Diet H-2

Table H-1. Ingredients of AIN-93M Maintenance Purified Rodent Diet

Ingredients	Percent by Weight
Corn starch	46.5692
Dextrin	15.5000
Casein (vitamin free)	14.0000
Sucrose	10.0000
Powdered cellulose	5.0000
Soybean oil	4.0000
AIN-93M mineral mix	3.5000
AIN-93M vitamin mix	1.0000
Choline bitartrate	0.2500
L-Cystine	0.1800
t-Butylhydroquinone	0.0008

Table H-2. Vitamins, Minerals, and Nutrient Composition of AIN-93M Maintenance Purified Rodent Diet

	Amount
Vitamins	
A	4.00 IU/g
D_3 (added)	1.00 IU/g
E	78.80 IU/g
K (as menadione)	0.75 ppm
Thiamine hydrochloride	6.00 ppm
Riboflavin	6.50 ppm
Niacin	30.00 ppm
Pantothenic acid	16.00 ppm
Folic acid	2.10 ppm
Pyridoxine	5.80 ppm
Biotin	0.20 ppm
B_{12}	28.00 mcg/kg
Choline chloride	1,250.00 ppm
Ascorbic acid	0.00 ppm
Minerals	
Calcium	0.50%
Phosphorus	0.31%
Potassium	0.36%
Magnesium	0.05%

	Amount
Sodium	0.13%
Chlorine	0.20%
Fluorine	1.00 ppm
Iron	39.00 ppm
Zinc	35.00 ppm
Manganese	11.00 ppm
Copper	6.00 ppm
Cobalt	0.00 ppm
Iodine	0.21 ppm
Chromium	1.00 ppm
Molybdenum	0.14 ppm
Selenium	0.22 ppm
Typical Analysis	
Protein	13.06%
Fat	4.00%
Fiber	5.00%
Carbohydrate	73.80%
Metabolizable energy	3.83%

Appendix I. Sentinel Animal Program

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I.2. Results I-3

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Table I-1. Laboratory Methods and Agents Tested for in the Sentinel Animal Program I-2

I.1. Methods

Rodents used in the National Toxicology Program are produced in optimally clean facilities to eliminate potential pathogens that may affect study results. The Sentinel Animal Program is part of the periodic monitoring of animal health that occurs during the toxicological evaluation of test compounds. Under this program, the disease state of the rodents is monitored via sera from extra (sentinel) animals in the study rooms. The sentinel animals and the study animals are subject to identical environmental conditions. Furthermore, the sentinel animals come from the same production source and weanling groups as the animals used for the studies of test compounds.

Blood samples were collected from each rat and allowed to clot and the serum was separated. All samples were processed appropriately and tested for the presence of pathogens at BioReliance Corporation (Rockville, MD) or the Research Animal Diagnostic Laboratory (RADIL), University of Missouri, Columbia, MO. The laboratory methods and agents for which testing was performed are tabulated below; the times at which samples were collected during the studies are also listed.

Blood was collected from five rats per sex per time point, except at study termination when blood was collected from four males and five females.

Table I-1. Laboratory Methods and Agents Tested for in the Sentinel Animal Program

Method and Test	Time of Collection
ELISA	
Kilham rat virus (KRV)	4 weeks
Pneumonia virus of mice (PVM)	End of quarantine, 4 weeks, study termination
Rat coronavirus/sialodacryoadenitis virus (RCV/SDA)	End of quarantine, 4 weeks, study termination
Rat parvovirus (RPV)	4 weeks
Sendai	End of quarantine, 4 weeks, study termination
Toolan's H-1 virus (H-1)	4 weeks
Immunofluorescence Assay	
H-1	4 weeks
KRV	4 weeks
Parvovirus	End of quarantine, 4 weeks, 6 weeks, study termination
RCV/SDA	End of quarantine
RPV	4 weeks
Multiplex Fluorescent Immunoassay	
H-1	6 weeks
KRV	6 weeks
Parvo NS-1	6 weeks
Rat minute virus	6 weeks
RPV	6 weeks

I.2. Results

A positive test result for parvovirus occurred in one animal at the 4-week timepoint; additional testing of serum from this animal and other sentinel animals via other testing methodologies deemed the original positive result to be a false positive. All other test results were negative for rodent pathogens.

National Toxicology Program

NTP Central Data Management, MD EC-03
National Institute of Environmental Health Sciences
P.O. Box 12233
Research Triangle Park, NC 27709

http://ntp.niehs.nih.gov

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Appendix G – Tidal Grow Citrus Canker Data Summary

Product Name: Spectra

Active Ingredient: Chitosan

Company Name: Tidal Grow AgriScience

Product Use Category: Crop Protection Aid, Plant Defense Enhancer, Fungicide

Application Justification

Spectra from Tidal Grow AgriScience is a liquid formulation containing 5.75% chitosan derived from crustacean exoskeletons. Chitosan is a known plant elicitor, activating the plant's natural systemic resistance mechanisms to enhance defense against fungal and bacterial pathogens. Foliar applied chitosan has shown to have plant disease control benefits when applied alone or in combination with numerous fungicides, including copper-based fungicides (ex. Kocide). The copper-based fungicides are unique in that they have been a cornerstone in disease management for over a century because of their efficacy. This effectiveness comes with the tradeoff that they persist in the environment in perennial systems as a heavy metal and their cost can be substantial for repeated usage. For these reasons, improving strategies that allow for a reduction in the copper application in a season without sacrificing the efficacy through the introduction of enhancing products like chitosan is important for producers and regulators alike. In studies conducted by Tidal Grow AgriScience, combinations of Spectra and Kocide enabled copper rate reduction while maintaining or improving disease control. This is a major step in addressing these tradeoffs.

Introduction to Field Evaluation in Citrus

To further investigate the potential for copper reduction strategies in perennial crop systems, a field-based efficacy study was conducted in commercial citrus groves in Florida. The trial focused on evaluating the integration of Spectra (5.75% chitosan) with Kocide copper fungicide in mature Valencia orange orchards under a diverse pathogen complex. Key target pathogens included *Xanthomonas citri* (citrus canker), *Phytophthora spp.*, *Septoria citri*, and *Colletotrichum gloeosporioides* (anthracnose), all of which contribute to premature fruit drop, foliar decline, and reduced marketable yield in high-value citrus production.

Given the widespread and repeated use of copper fungicides in these systems, the ability to maintain effective disease suppression while minimizing heavy metal accumulation and associated costs is a high priority for both growers and regulatory bodies. This study was designed to evaluate not only disease control outcomes, but also

potential ecological benefits, including soil copper load and early indicators of plant-microbe-soil system health.

Materials and Methods

This study was conducted at three commercial citrus groves in Florida: Frostproof (TDV2401F, 8-year-old trees), Duette (TDV2402F, 12–14-year-old trees), and Sebring (TDV2403F, 9-year-old trees), all planted to Valencia oranges (Citrus sinensis). The trial followed a randomized complete block design (RCBD), with five replicates per treatment. Each replicate consisted of three trees, flanked by two buffer trees on either side to minimize treatment drift. Disease and yield assessments were taken from four rating points per tree, across all blocks. Treatments were applied using calibrated foliar sprayers to replicate standard commercial application practices (Table 1). Timing and frequency of applications were aligned with disease pressure periods typical for Florida citrus, targeting *Xanthomonas citri*, *Phytophthora spp.*, *Septoria citri*, and *Colletotrichum gloeosporioides*.

The treatment list included 9 treatments. Note that treatments 8 and 9 are confidential, pre-commercial experimental materials. For statistical integrity of the RCBD design, the ANOVA results were run on all 9 treatments. But the results of treatments 8 and 9 have been redacted.

Table 1. Treatment List for Copper Reduction and Chitosan Elicitor Study							
No.	Treatment Name	Product(s)	Formulation Type	Rate	Unit	Application Code	Rationale
1	Untreated Check	—	—	—	—	—	Untreated control
2	Kocide – Full Rate	Kocide 3000	Dry (Copper hydroxide)	2.5	lb/acre	ADGJ	GSP – Commercial standard copper treatment
3	Kocide – 50% Rate	Kocide 3000	Dry	1.25	lb/acre	ABCEH	Reduced rate – Negative control
4	Kocide – Reduced Frequency	Kocide 3000	Dry	2.5	lb/acre	ACFI	Reduced application frequency – Negative control
5	Kocide Reduced Frequency + Spectra	Kocide 3000 + Spectra	Dry + Liquid (Chitosan, 5.75%)	2.5 lb + 12 fl oz	per acre	BE (Kocide), ACH (Spectra)	Can Spectra reduce copper use as part of a spray rotation
6	Kocide 50% + Spectra 50%	Kocide 3000 + Spectra	Dry + Liquid	1.25 lb + 6 fl oz	per acre	ADGJ	Can Spectra reduce copper usage when tank mixed at reduced rate
7	Kocide Full Rate + Spectra Full (Reduced Frequency)	Kocide 3000 + Spectra	Dry + Liquid	2.5 lb + 12 fl oz	per acre	CI (Kocide), AF (Spectra)	Evaluate extended control from combined application with reduced frequency
8	Experimental material included in protocol. Redacted as this is confidential, pre-commercial information.						
9	Experimental material included in protocol. Redacted as this is confidential, pre-commercial information.						

Results

The three Florida trial sites—Frostproof, Duette, and Sebring—represented a wide range of yield potential, with notable differences in overall productivity. However, key baseline factors such as trunk diameter and canopy volume showed no statistical differences prior to application, confirming that any treatment effects observed could be reliably compared across locations (Fig 1). This provided a sound basis for evaluating the performance of copper programs with and without Spectra under varying field conditions, while maintaining confidence in the integrity of disease, fruit drop, and yield comparisons.

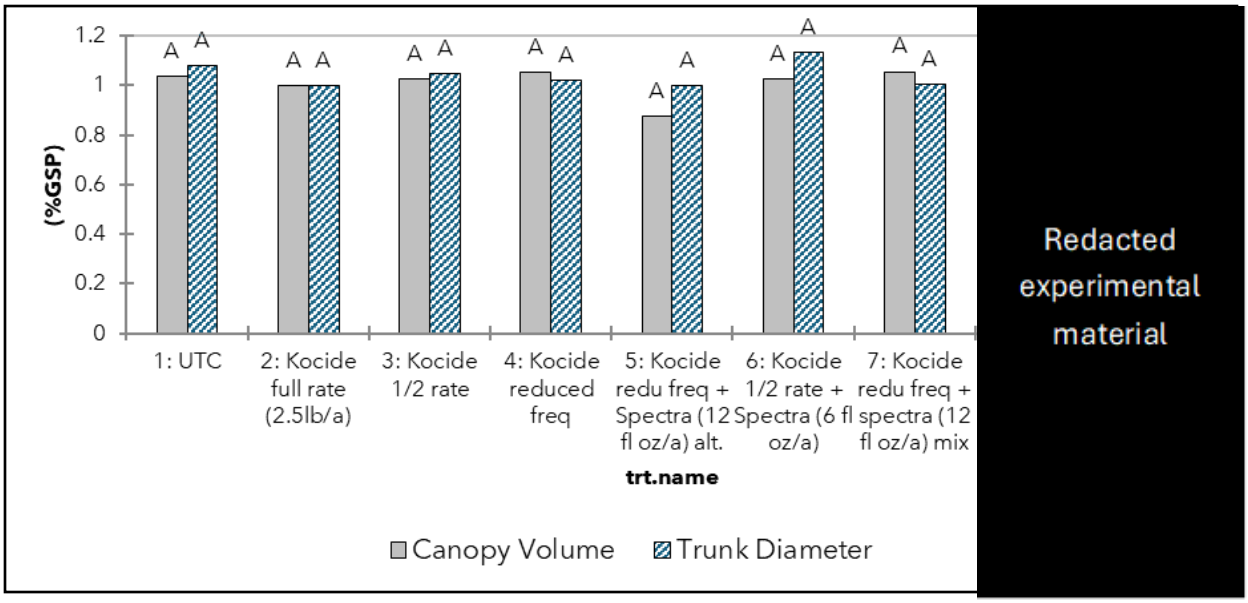

Fig 1. Canopy and trunk comparisons between treatments indicated no statistical variation between treatments.

Across all three Florida trial sites (Frostproof, Duette, and Sebring), Treatment 6, which consisted of Kocide at 0.5 rate tank-mixed with Spectra at 0.5 rate, consistently outperformed both the untreated control (UTC) and the full-rate Kocide grower standard program (GSP) (Fig 1). This combination provided a 10.6% improvement in citrus canker control (measured by SAUDPC), an 11.2% reduction in fruit drop, and a 17% directional increase in yield compared to the GSP, despite high variability and hurricane interference during the yield phase (Fig 2 & Fig 3). Notably, statistical significance was achieved in disease severity and fruit drop across all three sites when compared to UTC, and in two of three sites when compared to GSP (Fig 4). While yield increases were not statistically significant due to site variability, the trend was consistently positive (Fig 5). Importantly, this performance was achieved with a 50% reduction in metallic copper use, resulting in an

estimated $11/acre cost savings and $125/acre potential revenue gain, supporting both economic and environmental benefits. No phytotoxicity was observed, and soil copper levels remained stable. These results strongly support the utility of Spectra as a synergistic input to reduce copper reliance while enhancing disease management outcomes in citrus.

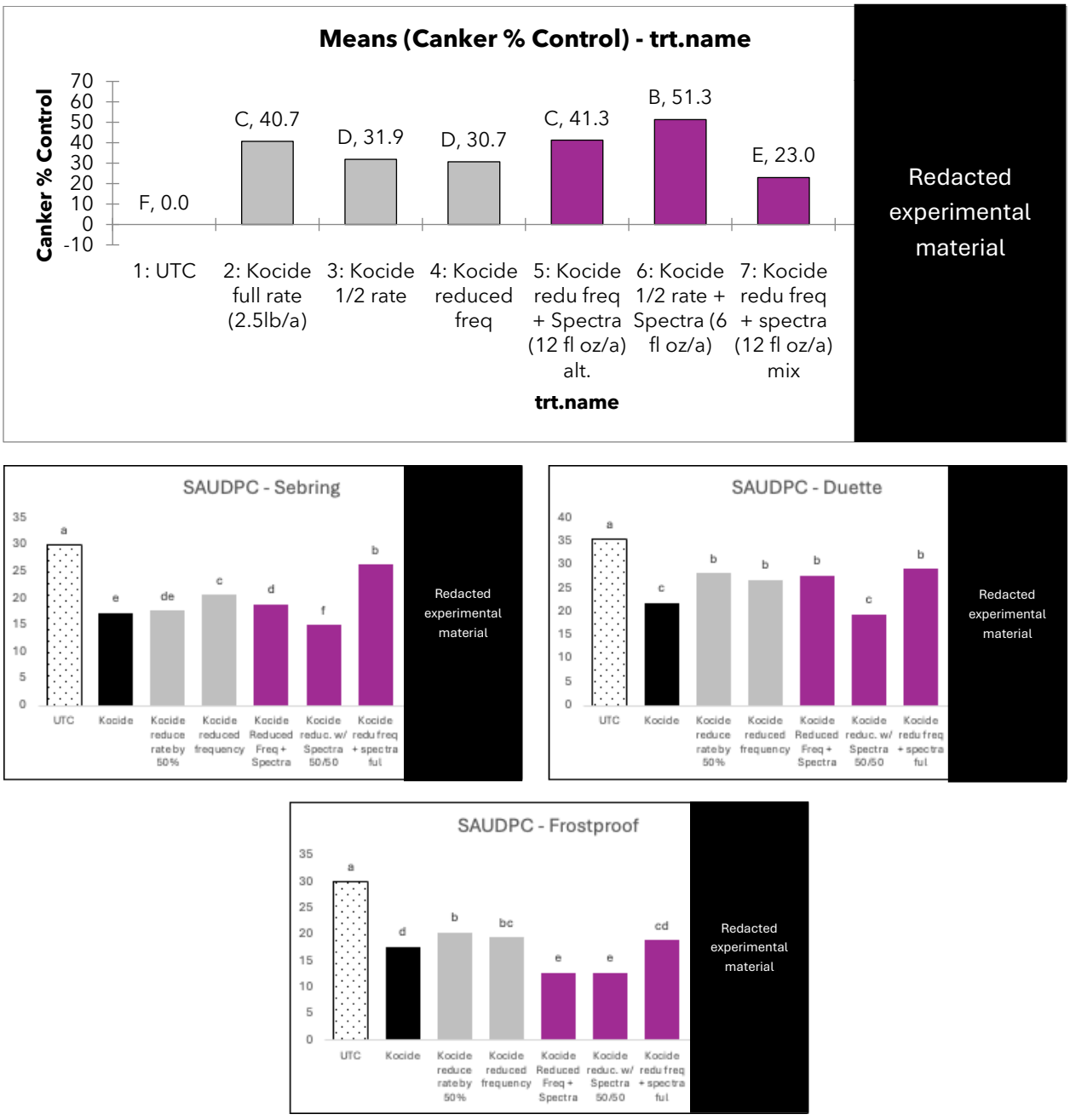

Fig 2 Standardized Area Under Disease Progress Curve for treatments at 3 locations in California under local management.

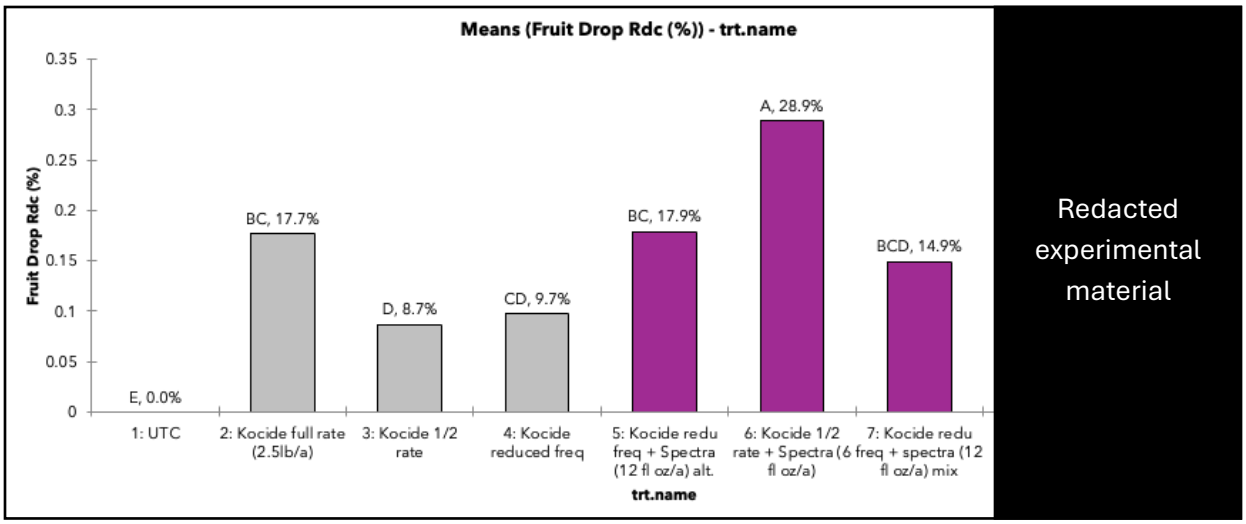

Fig 3 Citrus fruit drop percentage comparisons between treatments across all three locations.

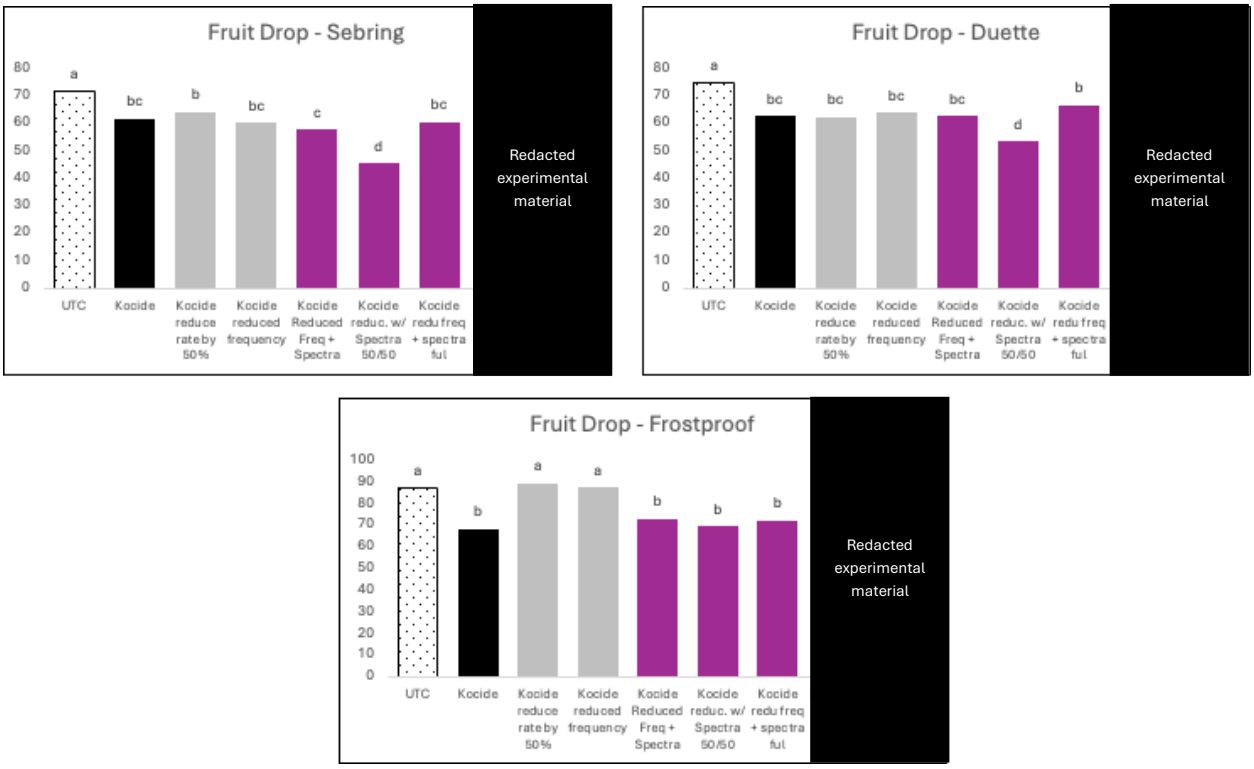

Fig 4 Citrus fruit drop percentage separated by treatment and individual locations of the experiment.

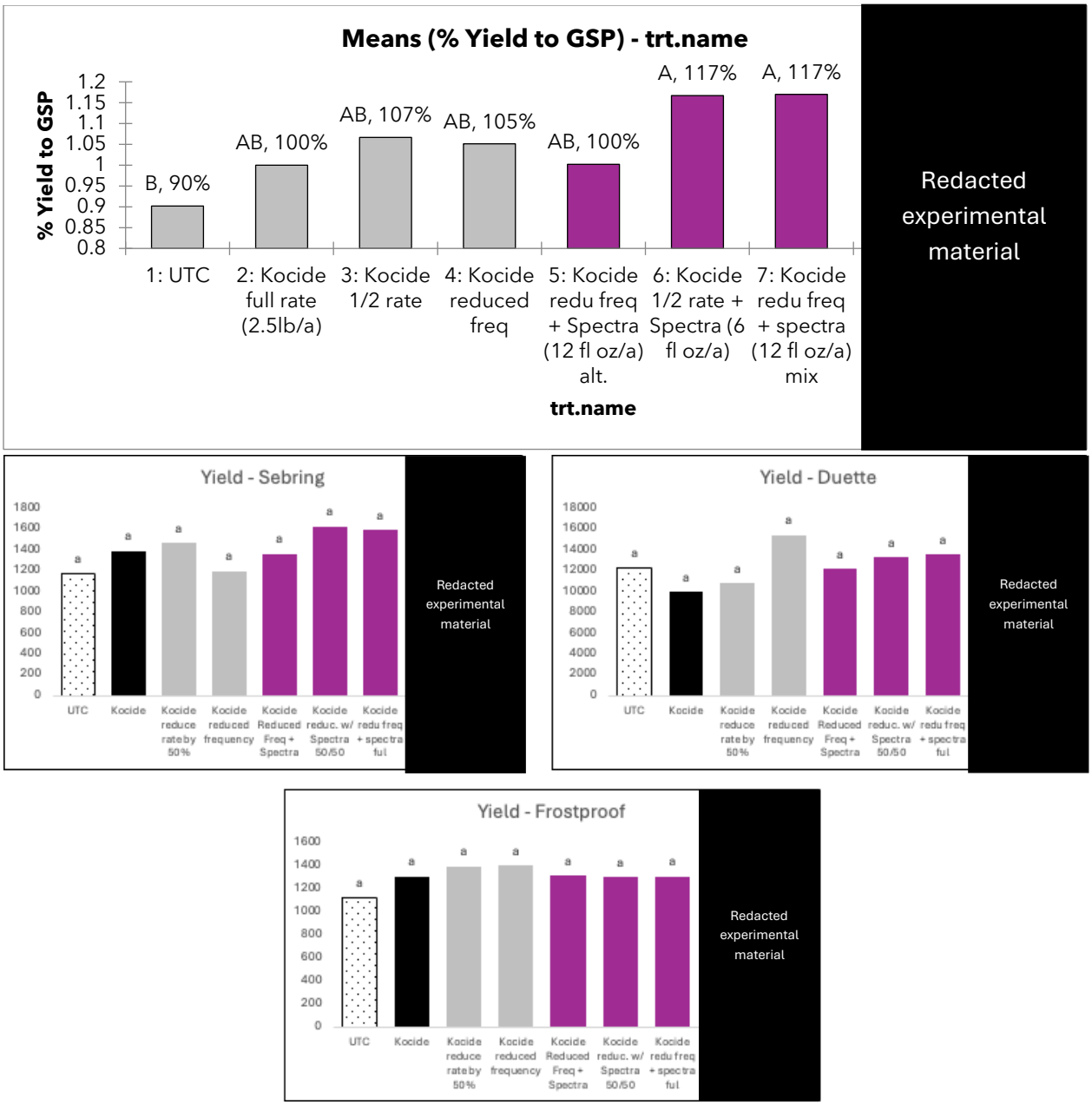

Fig 5 Season yield in lbs/ac for citrus under various copper fungicide protocols, separated by individual locations.

Discussion

The performance of the reduced-rate Kocide + Spectra tank mix (Treatment 6) was consistent across locations, showing measurable improvements in disease control and fruit drop reduction compared to both the untreated control and the grower standard program. While variability in site yield limited the ability to detect statistically significant yield differences, the directional trends across all sites support the potential benefit of this

combination. The fact that these improvements were observed with 50% less copper suggests that chitosan may enhance the efficacy of copper applications or help compensate for reduced rates. These outcomes are particularly relevant in the context of environmental concerns surrounding long-term copper accumulation and the increasing need for sustainable crop protection strategies.

The results also demonstrate that alternating Spectra and lower rates of Kocide can be an effective IPM strategy, equivalent to the full rate of Kocide, although the tank-mix (treatment 6) was both more economical and more effective. The results also demonstrate that tank mixing full rates of Spectra and Kocide and skipping application windows is not a recommended practice.

Conclusions

The results from this multi-site citrus trial indicate that a 50% reduced rate of copper hydroxide (Kocide), when tank-mixed with a reduced rate of Spectra chitosan, provided statistically significant improvements in disease control and fruit drop reduction compared to the untreated control and, in most cases, to the full-rate copper standard. While yield improvements for this treatment were directionally positive across all sites, they did not reach statistical significance due to high site-to-site yield variability and hurricane-related impacts. Importantly, this treatment achieved these outcomes while using half the standard amount of metallic copper, representing a meaningful reduction in environmental load without compromising disease management. These findings suggest that integrating chitosan with reduced-rate copper may be a viable strategy for maintaining efficacy while lowering copper input, particularly in systems facing regulatory or sustainability constraints.