Sunset 2028
Meeting 1 - Request for Public Comment
Crops Substances § 205.601 & § 205.602
Spring 2026

Introduction
As part of the Sunset Process, the National Organic Program (NOP) announces substances on the National List of Allowed and Prohibited Substances (National List) that are coming up for sunset review by the National Organic Standard Board (NOSB). The following list announces substances that must be reviewed by the NOSB and renewed by the USDA before their sunset dates. This document provides the substance's current status on the National List, annotation, references to past technical reports, past NOSB actions, and regulatory history, as applicable. If a new technical report has been requested for a substance, it is noted in this list. Substances included in this document may also be viewed in the NOP's Petitioned Substances Index.

Request for Comments
While the NOSB will not complete its review and any recommendations on these substances until the Fall 2026 public meeting, the NOP requests that the public provide comments about these substances to the NOSB as part of the Spring 2026 public meeting. Written comments should be submitted via Regulations.gov at www.regulations.gov during the comment period as explained in the meeting notice published in the Federal Register.

Public comments are necessary to guide the NOSB's review of each substance against the criteria in the Organic Foods Production Act (7 U.S.C. 6518(m)) and the USDA organic regulations (7 CFR 205.600). The current substances on the National List were originally recommended by the NOSB based on evidence available to the NOSB at the time of their last review, which demonstrated that the substances were: (1) not harmful to human health or the environment, (2) necessary because of the unavailability of wholly nonsynthetic alternatives, and (3) consistent and compatible with organic practices.

Public comments should clearly indicate the commentor's position on the allowance or prohibition of substances on the National List and explain the reasons for the position. Public comments should focus on providing relevant new information about a substance since its last NOSB review. Such information could include research or data that may support a change in the NOSB's determination for a substance (e.g., scientific, environmental, manufacturing, industry impact information, etc.). Public comment should also address the continuing need for a substance or whether the substance is no longer needed or in demand.

For Comments that Support the Continued Use of § 205.601 Substances in Organic Production:
If you provide comments supporting the allowance of a substance at § 205.601, you should provide information demonstrating that the substance is:
1. not harmful to human health or the environment;
2. necessary to the production of the agricultural products because of the unavailability of wholly nonsynthetic substitute products; and
3. consistent with organic crop production.

For Comments that Do Not Support the Continued Use of § 205.601 Substances in Organic Production:
If you provide comments that do not support a substance at § 205.601, you should provide reasons why the use of the substance should no longer be allowed in organic production. Specifically, comments that support the removal of a substance from the National List should provide new information since its last NOSB review to demonstrate that the substance is:
1. harmful to human health or the environment;

2. unnecessary because of the availability of alternatives; and/or
3. inconsistent with organic crop production.

For Comments that Support the Continued Prohibition of § 205.602 Substances in Organic Production:
If you provide comments supporting the prohibition of a substance on the § 205.602 section of the National List, you should provide information demonstrating that the substance is:

1. harmful to human health or the environment; and
2. inconsistent with organic crop production.

For Comments that Do Not Support the Continued Prohibition of § 205.602 Substances in Organic Production:
If you provide comments that do not support the prohibition of a substance at § 205.602, you should provide reasons why the use of the substance should no longer be prohibited in organic production. Specifically, comments that support the removal of a substance from the § 205.602 section of the National List should provide new information since its last NOSB review to demonstrate that the substance is:

1. not harmful to human health or the environment; and/or
2. consistent with organic crop production.

For Comments Addressing the Availability of Alternatives:
Comments may include information about the viability of alternatives for a substance under sunset review. Viable alternatives include, but are not limited to:

- Alternative management practices or natural substances that would eliminate the need for the specific substance;
- Other substances that are on the National List that are better alternatives, which could eliminate the need for this specific substance; and/or
- Other organic or nonorganic agricultural substances.

Your comments should address whether any alternatives have a function and effect equivalent to or better than the allowed substance, and whether you want the substance to be allowed or removed from the National List. Assertions about alternative substances, except for those alternatives that already appear on the National List, should, if possible, include the name and address of the manufacturer of the alternative. Further, your comments should include a copy or the specific source of any supportive literature, which could include product or practice descriptions, performance and test data, reference standards, names and addresses of organic operations who have used the alternative under similar conditions and the date of use, and an itemized comparison of the function and effect of the proposed alternative(s) with substance under review.

Written public comments will be accepted via www.regulations.gov during the open comment period noted in the Federal Register. Comments received after that date may not be reviewed by the NOSB before the meeting.

§ 205.601 Sunsets: Synthetic substances allowed for use in organic crop production:

- Chlorine materials
  - (i) Calcium hypochlorite
  - (ii) Chlorine dioxide
  - (iii) Hypochlorous acid - generated from electrolyzed water
  - (iv) Sodium hypochlorite
- Copper sulfate (§ 205.601(a)(3) & § 205.601(e)(4))

- Ozone gas
- Peracetic acid (§ 205.601(a)(6) & § 205.601(i)(8))
- Magnesium oxide
- EPA List 3 - Inerts of unknown toxicity

§ 205.602 Sunsets: Nonsynthetic substances prohibited for use in organic crop production:

- Calcium chloride
- Rotenone

Chlorine materials – Calcium hypochlorite

Reference: § 205.601(a) - As algicide, disinfectants, and sanitizer, including irrigation system cleaning systems. (2) Chlorine materials -For pre-harvest use, residual chlorine levels in the water in direct crop contact or as water from cleaning irrigation systems applied to soil must not exceed the maximum residual disinfectant limit under the Safe Drinking Water Act, except that chlorine products may be used in edible sprout production according to EPA label directions.

(i) Calcium hypochlorite

Technical Report(s): 1995 TAP; 2006 TR; 2011 TR; 2025 TR (pending post)
Petition(s): N/A
Past NOSB Actions: 10/1995 NOSB minutes and vote; 04/2006 NOSB sunset recommendation; 04/2011 NOSB sunset recommendation; 10/2015 sunset recommendation; 11/2017 sunset recommendation; 10/2021 sunset recommendation
Recent Regulatory Background: Added to National List 02/20/2001 (65 FR 80547), Sunset renewal notice 03/21/2017 (82 FR 14420); Sunset renewal notice effective 10/30/2019 (84 FR 53577); Sunset renewal notice 04/14/2023 (88 FR 22893)
Sunset Date: 05/29/2028

Subcommittee Review

Use
In addition to USDA, chlorine materials are regulated by FDA, EPA, and FSIS when used in organic production [2025 TR, line 429]. Calcium hypochlorite, a chlorine material, is an Environmental Protection Agency (EPA)-pesticide (PC Code 014701). The EPA approved the registration of calcium hypochlorite pesticides for use on crops, soil, and livestock to control bacteria, fungi, and slime-forming algae that can cause diseases in people and animals [2025 TR, lines 444-445]. It is an antimicrobial disinfectant and pesticide used to control harmful microorganisms and viruses on inanimate objects and surfaces primarily in indoor environments [2006 TR, lines 66-67, 85-86]. It is allowed for disinfecting and sanitizing food contact surfaces. An important annotation for the use of this and other chlorine materials is that residual chlorine levels for wash water in direct crop or food contact and in flush water from cleaning irrigation systems that is applied to crops or fields, should not exceed the maximum residual disinfectant limit under the Safe Drinking Water Act (SDWA) (currently 4mg/L expressed as Cl_2) [2006 TR, lines 77-79]. Information provided by three NOP-accredited certifying agents revealed that only one certifier had approved the use of chlorine products in irrigation systems. The certifier stated that the most common chlorine product used for irrigation systems was calcium hypochlorite.

Calcium hypochlorite is an "indirect" food additive approved by the Food and Drug Administration (FDA). Calcium hypochlorite may be used as a final sanitizing rinse on food-processing equipment (21 CFR 178.1010). Calcium hypochlorite also can be used in postharvest, seed, or soil treatment on various fruit and vegetable crops [2006 TR, lines 93-99].

For organic food handling facilities and equipment, chlorine materials may be used up to maximum-labeled rates for disinfecting and sanitizing food contact surfaces. Rinsing is not required unless mandated by the label use directions. Water used in direct post-harvest crop or food contact (including flume water to transport fruits or vegetables, wash water in produce lines, egg or carcass washing) is permitted to contain chlorine materials at levels approved by the FDA or the EPA for such purposes. Rinsing with potable water that does not exceed the maximum residual disinfectant limit for the chlorine material under the SDWA must immediately follow this permitted use. Certified operators should monitor the chlorine level of the final rinse water at the point at which the water last contacts the organic product. The level of chlorine in the final rinse water must meet limits as set forth by the SDWA.

Water used as an ingredient in organic food handling should not exceed the maximum residual disinfectant limit for the chlorine material under the SDWA, as required by the Organic Food Production Act (7 U.S.C. 6510(a)(7)).

Manufacture
Calcium hypochlorite is produced by passing chlorine gas over hydrated (slaked) lime. It is then separated from the coproduct, calcium chloride, and air dried or vacuum dried [2006 TR, lines 151-152].

International Acceptance
Canadian General Standards Board Allowed Substances List (CAN/CGSB 32.311-2020)

- The following chlorine compounds are permitted: a) calcium hypochlorite; b) chlorine dioxide; c) hypochlorous acid generated via electrolyzed water; d) sodium hypochlorite. Shall not exceed maximum levels for safe drinking water. Chlorine compounds may be used: a) for wash water in direct contact with crops or food; b) in flush water from cleaning irrigation systems, equipment, storage or transport units—application to crops or fields is permitted (Table 7.3 - Food-grade cleaners, disinfectants and sanitizers permitted without a mandatory removal event, CAN/CGSB-32.311-2020).
- The following chlorine compounds are permitted up to maximum label rates: a) calcium hypochlorite; b) chlorine dioxide; c) hypochlorous acid generated via electrolyzed water; d) sodium hypochlorite (Table 7.4 - Cleaners, disinfectants and sanitizers permitted on organic product contact surfaces for which a removal event is mandatory, CAN/CGSB-32.311-2020).

European Economic Community (EEC) Council Regulation, EC No. 2018/848 and 2021/1165

- Calcium hypochlorite is not explicitly mentioned in the regulations.

CODEX Alimentarius Commission, Guidelines for the Production, Processing, Labelling and Marketing of Organically Produced Foods (CXG 32-1999)

- Calcium hypochlorite is not explicitly mentioned in the regulations.

International Federation of Organic Agriculture Movements (IFOAM) Norms

- Calcium hypochlorite is permitted with the following limitation: an intervening event or action must occur to eliminate risks of contamination (Appendix 4, Table 2: Indicative list of equipment cleansers and equipment disinfectants, IFOAM NORMS 2014).

Japan Agricultural Standard (JAS) for Organic Production

- Calcium hypochlorite is not explicitly mentioned in the regulations.

Human Health and Environmental Issues
Chlorine sanitizing compounds currently on the National List are strong oxidants and can pose serious risks to human health if acute high exposures occur or from chronic lower-level exposures – especially in occupational environments when these materials are used daily. Chlorine compounds are dermal, respiratory, ocular, and mucous membrane irritants. In addition, sodium hypochlorite (bleach) can cause asthma, as classified by the Association of Occupational and Environmental Clinics. Given the similar chemical properties and mechanisms of action, other chlorine-based oxidant sanitizers are also likely to cause asthma. Chlorine compounds are toxic to fish and other aquatic organisms. Strict adherence to the label is required when used, including the use of personal protective equipment when appropriate. Use of chlorine compounds in organic processing and crop production have been reviewed in the 2006, 2011 and 2025 Technical Reports (TR) (referenced above). In 1991 the US Environmental Protection Agency reported that calcium hypochlorite is highly toxic to freshwater fish and invertebrates [2025 TR, lines 718-

719]. In 1992 the EPA also stated that sodium and calcium hypochlorite were low risk to both upland game birds (quail) and waterfowl (ducks) [2025 TR, lines 733-734].

The EPA exempts calcium hypochlorite (40 CFR 180.1054), potassium hypochlorite (40 CFR 180 1300), and sodium hypochlorite (40 CFR 180.1235) from the requirement of a tolerance in food [2025 TR, lines 446-447].

In 2025 the US EPA reported that 88 of the 651 chlorine material incidents reported to the US EPA'S Incident Data System between September 1, 2010 and September 1, 2025 were due to calcium hypochlorite [2025 TR, lines 802-805]. Sodium hypochlorite accounted for 556 of the reported incidents. Most of the incidents involved humans and were classified as either minor or moderate. No human fatality and one animal fatality was recorded for Calcium hypochlorite.

Discussion

Subcommittee discussions during the sunset review of Calcium Hypochlorite's in 2021covered comments from various stakeholders on its essentiality as well as impact on human and environmental health. Below is a summary of discussions and public comments on calcium hypochlorite during its last sunset review in 2021.

Arguments in support of Calcium hypochlorite include its use in protecting food from contamination by human pathogens which is essential in safeguarding organic integrity. Despite the potential for significant risks to human health and the environment, chlorine compounds have been deemed essential to ensure food safety and to comply with food safety regulations under the Food Safety Modernization Act (FSMA). The Crops Subcommittee (CS) generally supported the continued listing of chlorine materials but encouraged ongoing discussion (at the time) on the listing of sanitizers and disinfectants for post-harvest handling and processing. Some public comments outlined the need for a comprehensive technical review of sanitizers and listing of sanitizers on the National List itemized "by specific use or application" with clear identification of the hazards to humans and the environment. It was said that further restructuring of the National List with a designated category for cleaners, sanitizers and disinfectants would help to ensure certified operations understand which cleaners, sanitizers and disinfectants may be used and would facilitate better organic education.

The CS, in 2021, stated its support for research priorities that investigate alternatives to chlorine compounds and encouraged the use of alternative, less toxic materials, when their use can meet strict food safety standards.

In the 2025 sunset review of another chlorine material (potassium hypochlorite), the CS received public comments that were not supportive of the proposed annotation requiring the use of chlorine produced via environmentally friendly methods in the synthetic production of chlorine materials.

Questions to our Stakeholders

None.

Chlorine materials – Chlorine dioxide

Reference: § 205.601(a) - As algicide, disinfectants, and sanitizer, including irrigation system cleaning systems. (2) Chlorine materials - For pre-harvest use, residual chlorine levels in the water in direct crop contact or as water from cleaning irrigation systems applied to soil must not exceed the maximum residual disinfectant limit under the Safe Drinking Water Act, except that chlorine products may be used in edible sprout production according to EPA label directions.

(ii) Chlorine dioxide

Technical Report(s): 1995 TAP; 2006 TR; 2011 TR; 2025 TR (pending post)
Petition(s): N/A
Past NOSB Actions: 10/1995 NOSB minutes and vote; 04/2006 NOSB sunset recommendation; 04/2011 NOSB sunset recommendation; 10/2015 sunset recommendation; 11/2017 sunset recommendation; 10/2021 sunset recommendation
Recent Regulatory Background: Added to National List 02/20/2001 (65 FR 80547); Sunset renewal notice 03/21/2017 (82 FR 14420); Sunset renewal notice effective 10/30/2019 (84 FR 53577); Sunset renewal notice 04/14/2023 (88 FR 22893)
Sunset Date: 05/29/2028

Subcommittee Review

Use
In addition to USDA, chlorine materials are regulated by FDA, EPA, and FSIS when used in organic production [2025 TR, line 429]. Chlorine dioxide is an antimicrobial disinfectant and pesticide used to control harmful microorganisms including bacteria, viruses, and fungi on inanimate objects and surfaces primarily in indoor environments [2006 TR, lines 66-67]. It is allowed for disinfecting and sanitizing food contact surfaces. Residual chlorine levels for wash water in direct crop or food contact and in flush water from cleaning irrigation systems that is applied to crops or fields cannot exceed the maximum residual disinfectant limit under the Safe Drinking Water Act (currently 4mg/L expressed as Cl_2).

For organic food handling facilities and equipment, chlorine materials may be used up to maximum-labeled rates for disinfecting and sanitizing food contact surfaces. Rinsing is not required unless mandated by the label use directions. The FDA permits direct food use of chlorine dioxide to wash fruits and vegetables. The maximum amount of ClO_2 allowed is 3 ppm for fruits and vegetables, followed by a potable water rinse, blanching, cooking, or canning [2025 TR, lines 482-485]. Water used in direct post-harvest crop or food contact (including flume water to transport fruits or vegetables, wash water in produce lines, egg or carcass washing) is permitted to contain chlorine materials at levels approved by the Food and Drug Administration (FDA) or the Environmental Protection Agency (EPA) for such purposes. Rinsing with potable water that does not exceed the maximum residual disinfectant limit for the chlorine material under the SDWA must immediately follow this permitted use. Certified operators should monitor the chlorine level of the final rinse water at the point at which the water last contacts the organic product. The level of chlorine in the final rinse water must meet limits as set forth by the SDWA. Water used as an ingredient in organic food handling should not exceed the maximum residual disinfectant limit for the chlorine material under the SDWA, as required by the Organic Food Production Act (7 U.S.C. 6510(a)(7)).

Chlorine dioxide is a strong oxidant. It is likely a better bactericide than hypochlorous acid. In general, the disinfection efficiency of chlorine dioxide decreases as temperature decreases (2011 TR, lines 149-150).

Manufacture

To form chlorine dioxide, sodium chlorate ($NaClO_3$) and sulfuric acid (H_2SO_4) are reacted with sulfur dioxide (SO_2), or chloric acid ($Cl\text{-}H\text{-}O_3$) is reacted with methanol (CH_3OH). Alternatively, chlorine dioxide can be formed with chlorine (Cl_2) and sodium chlorite; sodium hypochlorite with hydrochloric acid; potassium chlorate with sulfuric acid; or by passing nitrogen dioxide through a column of sodium chlorate (2011 TR, lines 206-210).

International Acceptance

Canadian General Standards Board Allowed Substances List (CAN/CGSB 32.311-2020)

- Teat dips and udder wash are permitted. Substances, such as alcohol, iodine, hydrogen peroxide, chlorine dioxide and ozone, can be used as disinfectants for a pre- or post-teat dip or udder wash if they are registered for this use by Canada's Food and Drug Regulations. Chlorhexidine can be used as a post-milking teat dip if alternative germicidal agents and physical barriers have lost their effectiveness (Table 5.3 - Health care products and production aids, CAN/CGSB-32.311-2020).
- The following chlorine compounds are permitted: a) calcium hypochlorite; b) chlorine dioxide; c) hypochlorous acid generated via electrolyzed water; d) sodium hypochlorite. Shall not exceed maximum levels for safe drinking water. Chlorine compounds may be used: a) for wash water in direct contact with crops or food; b) in flush water from cleaning irrigation systems, equipment, storage or transport units—application to crops or fields is permitted (Table 7.3 - Food-grade cleaners, disinfectants and sanitizers permitted without a mandatory removal event, CAN/CGSB-32.311-2020).
- The following chlorine compounds are permitted up to maximum label rates: a) calcium hypochlorite; b) chlorine dioxide; c) hypochlorous acid generated via electrolyzed water; d) sodium hypochlorite (Table 7.4 - Cleaners, disinfectants and sanitizers permitted on organic product contact surfaces for which a removal event is mandatory, CAN/CGSB-32.311-2020).

European Economic Community (EEC) Council Regulation, EC No. 2018/848 and 2021/1165

- Chlorine dioxide is not explicitly mentioned in the regulations.

CODEX Alimentarius Commission, Guidelines for the Production, Processing, Labelling and Marketing of Organically Produced Foods (CXG 32-1999)

- Chlorine dioxide is not explicitly mentioned in the regulations.

International Federation of Organic Agriculture Movements (IFOAM) Norms

- Chlorine dioxide is permitted with the following limitation: an intervening event or action must occur to eliminate risks of contamination (Appendix 4, Table 2: Indicative list of equipment cleansers and equipment disinfectants, IFOAM NORMS 2014).

Japan Agricultural Standard (JAS) for Organic Production

- Chlorine dioxide is not explicitly mentioned in the regulations.

Human Health and Environmental Issues

Chlorine sanitizing compounds currently on the National List are strong oxidants and can pose serious risks to human health if acute high exposures occur or from chronic lower-level exposures – especially in occupational environments when these materials are used daily. Chlorine compounds are dermal, respiratory, ocular, and mucous membrane irritants. Sodium hypochlorite (bleach) can cause asthma, as classified by the Association of Occupational and Environmental Clinics. Given the similar chemical properties and mechanisms of action, other chlorine-based oxidant sanitizers are also likely to cause asthma. Chlorine compounds are toxic to fish and other aquatic organisms. Strict adherence to the label is required when used, including the use of personal protective equipment when appropriate. Use of chlorine compounds in organic processing and crop production have been reviewed in the 2006, 2011, and 2025 Technical Reports (TR) (referenced above).

The EPA established Maximum Residual Disinfectant Levels (MRDLs) of 4.0 mg/L for chloramines (as Cl_2), and 0.8 mg/L for chlorine dioxide (as ClO_2) (40 CFR 141.65(a). In addition, the EPA established Maximum Contaminant Levels (MCLs) for the chlorine disinfection by-products (DBPs) total trihalomethanes (TTHMs) of 0.080 mg/L and haloacetic acids (HAAs) of 0.060 mg/L (40 CFR 141.64(b)(1) [2025 TR, lines 495-498].

Discussion

Subcommittee discussions during the sunset review of Chlorine dioxide in 2021 covered comments from various stakeholders on its essentiality as well as impact on human and environmental health. Below is a summary of discussions and public comments on Chlorine dioxide during its last sunset review in 2021. Arguments in support of Chlorine dioxide and other chlorine materials include its use in protecting food from contamination by human pathogens which is essential in safeguarding organic integrity. Despite the potential for significant risks to human health and the environment, chlorine compounds have been deemed essential to ensure food safety and to comply with food safety regulations under the Food Safety Modernization Act (FSMA). The Crops Subcommittee (CS) generally supported the continued listing of chlorine materials but encouraged ongoing discussion at the time on the listing of sanitizers and disinfectants for post-harvest handling and processing. Some public comments outlined the need for a comprehensive technical review of sanitizers and listing of sanitizers on the National List itemized "by specific use or application" with clear identification of the hazards to humans and the environment. It was said that further restructuring of the National List with a designated category for cleaners, sanitizers and disinfectants would help to ensure certified operations understand which cleaners, sanitizers and disinfectants may be used and would facilitate better organic education.

The CS in 2021 stated its support for research priorities that investigate alternatives to chlorine compounds and encouraged the use of alternative, less toxic materials, when their use can meet strict food safety standards.

In the 2025 sunset review of another chlorine material (potassium hypochlorite), the CS received public comments that were not supportive of the proposed annotation requiring the use of chlorine produced using environmentally friendly methods in the synthetic production of chlorine materials. It was stated that this annotation would make it difficult to obtain chlorine materials that meet this requirement.

Questions to our Stakeholders

None

Chlorine materials – Hypochlorous acid – generated from electrolyzed water

Reference: § 205.601(a) - As algicide, disinfectants, and sanitizer, including irrigation system cleaning systems. (2) Chlorine materials -For pre-harvest use, residual chlorine levels in the water in direct crop contact or as water from cleaning irrigation systems applied to soil must not exceed the maximum residual disinfectant limit under the Safe Drinking Water Act, except that chlorine products may be used in edible sprout production according to EPA label directions.

(iii) Hypochlorous acid - generated from electrolyzed water.

Technical Report(s): 1995 TAP (Chlorine materials); 2006 TR (Chlorine materials); 2011 TR (Chlorine materials); 2015 TR (Hypochlorous acid); 2025 TR (pending post)

Petition(s): 2015

Past NOSB Actions: 04/2016 recommendation to add; 10/2021 sunset recommendation

Recent Regulatory Background: Added to NL 12/27/2018 (83 FR 66559); Sunset renewal notice 04/14/2023 (88 FR 22893)
Sunset Date: 05/29/2028

Subcommittee Review

Use
Hypochlorous acid (HOCl) is the most effective form of chlorine for killing microbial pathogens and parasites that pose food safety risks [2025 TR, lines 504-506]. In addition to USDA, chlorine materials are regulated by FDA, EPA, and FSIS when used in organic production [2025 TR, line 429]. It is allowed for disinfecting and sanitizing food contact surfaces. Residual chlorine levels for wash water in direct crop or food contact and in flush water from cleaning irrigation systems that is applied to crops or fields cannot exceed the maximum residual disinfectant limit under the Safe Drinking Water Act (currently 4mg/L expressed as Cl_2). For organic food handling facilities and equipment, chlorine materials may be used up to maximum-labeled rates for disinfecting and sanitizing food contact surfaces. Rinsing is not required unless mandated by the label use directions.

Water used in direct post-harvest crop or food contact (including flume water to transport fruits or vegetables, wash water in produce lines, egg or carcass washing) is permitted to contain chlorine materials at levels approved by the Food and Drug Administration (FDA) or the Environmental Protection Agency (EPA) for such purposes. Rinsing with potable water that does not exceed the maximum residual disinfectant limit for the chlorine material under the SDWA must immediately follow this permitted use. Certified operators should monitor the chlorine level of the final rinse water, the point at which the water last contacts the organic product. The level of chlorine in the final rinse water must meet limits as set forth by the SDWA. Water used as an ingredient in organic food handling should not exceed the maximum residual disinfectant limit for the chlorine material under the SDWA, as required by the Organic Food Production Act (7 U.S.C. 6510(a)(7)).

Hypochlorous acid molecules are neutral and small in size. As a result, when hypochlorous acid molecules exist in equilibrium with hypochlorite ions, they easily diffuse through the cell walls of bacteria. This changes the oxidation-reduction potential of the cell and inactivates 3-phosphate dehydrogenase, an enzyme which is essential for the digestion of glucose. Inactivation of this enzyme effectively destroys the microorganism's ability to function [2006 TR, lines 118-122].

Manufacture
When chlorine is added to water, it goes into solution as hypochlorous acid, a hydrogen ion, and a chloride ion (2025 TR, line 540). Electrolyzed water (EW) is the product of the electrolysis of a dilute sodium chloride solution in an electrolysis cell containing a semi-permeable membrane that physically separates the anode and cathode but permits ions to pass through. In the process, hypochlorous acid, hypochlorite ion, and hydrochlorite acid are formed at the anode, and sodium hydroxide is formed at the cathode. The solution formed on the anode side is acidic EW (pH 2 to 6), and the solution formed on the cathode side is basic EW (pH 7.5 to 13). Neutral EW, with a pH of 6 to 7.5 is produced by mixing the anodic solution with hydroxide, or by using a single-cell chamber for electrolysis [2015 TR lines 48-68].

International Acceptance
Canadian General Standards Board Allowed Substances List (CAN/CGSB 32.311-2020)
- The following chlorine compounds are permitted: a) calcium hypochlorite; b) chlorine dioxide; c) hypochlorous acid generated via electrolyzed water; d) sodium hypochlorite. Shall not exceed maximum levels for safe drinking water. Chlorine compounds may be used: a) for wash water in direct contact with crops or food; b) in flush water from cleaning irrigation systems, equipment,

storage or transport units—application to crops or fields is permitted (Table 7.3 - Food-grade cleaners, disinfectants and sanitizers permitted without a mandatory removal event, CAN/CGSB-32.311-2020).

- The following chlorine compounds are permitted up to maximum label rates: a) calcium hypochlorite; b) chlorine dioxide; c) hypochlorous acid generated via electrolyzed water; d) sodium hypochlorite (Table 7.4 - Cleaners, disinfectants and sanitizers permitted on organic product contact surfaces for which a removal event is mandatory, CAN/CGSB-32.311-2020).

European Economic Community (EEC) Council Regulation, EC No. 2018/848 and 2021/1165

- Hypochlorous acid is not explicitly mentioned in the regulations.

CODEX Alimentarius Commission, Guidelines for the Production, Processing, Labelling and Marketing of Organically Produced Foods (CXG 32-1999)

- Hypochlorous acid is not explicitly mentioned in the regulations.

International Federation of Organic Agriculture Movements (IFOAM) Norms

- Hypochlorous acid is not explicitly mentioned in the regulations.

Japan Agricultural Standard (JAS) for Organic Production

- Any substances other than hypochlorous acid water and sodium hypochlorite, both of which are specified in Table D.1, should not be used for the seeds specified in 5.6.1 (Seeds used in cultivation facilities of sprout, JAS 1605 Organic Products of Plant Origin).
- Sodium hypochlorite is permitted with the following criteria: limited to the use in processed products of plant origin (limited to the use of hypochlorous acid water produced by electrolyzing salt water (limited to the use of salt containing 99% or more sodium chloride)), or the use for disinfecting the intestines of livestock animals for processed meat products, or cleaning of eggs (Table A.1 - Additives for organic processed foods excluding organic alcohol beverages, JAS 1606 Organic Processed Foods).
- Hypochlorous acid water is permitted with the following criteria: limited to the use only for the purpose of disinfecting meat in the process of dismantling or cleaning eggs (Table K.1 - Substances for preparation or other purposes, JAS 1608 Organic Livestock Products).

Human Health and Environmental Issues

Hypochlorous acid, generated from electrolyzed water [2025 TR, line 59], is present in solutions of two chlorine sanitizers (sodium hypochlorite and calcium hypochlorite) currently allowed at § 205.601(a)(2)(i, ii). Like other chlorine compounds, hypochlorous acid is also an oxidant and can pose risks to human health. Strict adherence to the label is required when used, including the use of personal protective equipment when appropriate. Use of chlorine compounds in organic processing and crop production have been reviewed in the 2006, 2011, and 2025 Technical Reports (TR) (referenced above). When formulated via electrolyzed water, hypochlorous acid is effective as a sanitizer at lower chlorine concentrations and is likely safer for health and the environment than other currently listed chlorine sanitizers. Toxicological experiments on model laboratory animals showed that hypochlorous acid salts are less toxic than chlorine dioxide or sodium chlorite [2025 TR, line 739]. In 1991 the International Agency for Research on Cancer stated that there was no evidence that hypochlorite salts or chlorinated drinking water are carcinogenic [2025 TR, line 786].

In 2025 the US EPA reported that 1 of the 651 chlorine material incidents reported to the US EPA'S Incident Data System between September 1, 2010 and September 1, 2025 were due to hypochlorous acid [2025 TR, lines 802-807]. Sodium hypochlorite accounted for 556 of the reported incidents. Most of the incidents involved humans and were classified as either minor or moderate. No human or animal fatality was recorded for hypochlorous acid.

Chlorine disinfection byproducts (DBPs) are formed when chlorine in water reacts with natural organic matter. It is, however, important to note that not all toxic DBPs formed by chlorine products contain chlorine. Humic acid exposed to chlorine and hypochlorous acid disinfectants can also form benzene, aldehydes, alkanoic acids, carboxylic acids, and other non-halogenated DBPs when the free chlorine breaks the chemical bonds in the organic matter.
A laboratory experiment treated soil samples with a sodium hypochlorite solution and a hypochlorous acid solution to measure soil enzyme activity [2025 TR, lines 1280-1288]. Soil samples were treated with commercial disinfectants with low concentrations of 250 mg/L and high concentrations of 500 mg/L of each of the active ingredients. The researchers measured THMs after 24 hours. Hypochlorous acid generated higher levels of THMs with trichloromethane being the predominant DBP. They next measured urease, phosphatase, catalase, and sucrase activity at 7 days and 28 days. Phosphatase showed decreased activity with all treatments. Catalase, which is an oxygen scavenger, increased its activity. Urease activity decreased with the sodium hypochlorite treatments but increased with the low hypochlorous acid treatment. Plant available nitrogen in the form of ammonia is produced by urease activity. Sucrase activity was unchanged [2025 TR, lines 1280-1288]. Hypochlorous acid reportedly kills a broader range of microorganisms than any other approved sanitizer [2025 TR, lines 1296-1297] . Effective alternatives will often incur a higher cost, may require investment in new equipment, and in many cases will be less effective [2025 TR, lines 1297-1298].

Discussion
Subcommittee discussions during the sunset review of hypochlorous acid covered comments from various stakeholders on its essentiality as well as impact on human and environmental health. Below is a summary of discussions and public comments on hypochlorous acid during its last sunset review.

Arguments in support of hypochlorous acid include its use in protecting food from contamination by human pathogens which is essential in safeguarding organic integrity. Despite the potential for significant risks to human health and the environment, chlorine compounds have been deemed essential to ensure food safety and to comply with food safety regulations under the Food Safety Modernization Act (FSMA). The Crops Subcommittee (CS) generally supported the continued listing of chlorine materials but encouraged ongoing discussion at the time on the listing of sanitizers and disinfectants for post-harvest handling and processing. Some public comments outlined the need for a comprehensive technical review of sanitizers and listing of sanitizers on the National List itemized “by specific use or application” with clear identification of the hazards to humans and the environment. It was said that further restructuring of the National List with a designated category for cleaners, sanitizers and disinfectants would help to ensure certified operations understand which cleaners, sanitizers and disinfectants may be used and would facilitate better organic education.

In the 2025 sunset review of another chlorine material (potassium hypochlorite), the CS received public comments that were not supportive of the proposed annotation requiring the use of chlorine produced using environmentally friendly methods in the synthetic production of chlorine materials. It was stated that this annotation would make it difficult to obtain chlorine materials that meet this requirement.

Questions to our Stakeholders
None

Chlorine materials – Sodium hypochlorite

Reference: § 205.601(a) - As algicide, disinfectants, and sanitizer, including irrigation system cleaning systems. (2) Chlorine materials -For pre-harvest use, residual chlorine levels in the water in direct crop contact or as water from cleaning irrigation systems applied to soil must not exceed the maximum residual disinfectant limit under the Safe Drinking Water Act, except that chlorine products may be used in edible sprout production according to EPA label directions.

(iv) Sodium hypochlorite

Technical Report(s): 1995 TAP; 2006 TR; 2011 TR; 2025 TR (pending post)
Petition(s): N/A
Past NOSB Actions: 10/1995 NOSB minutes and vote; 04/2006 NOSB sunset recommendation; 04/2011 NOSB sunset recommendation; 10/2015 sunset recommendation; 11/2017 sunset recommendation; 10/2021 sunset recommendation
Recent Regulatory Background: Added to National List 02/20/2001 (65 FR 80547), Sunset renewal notice 03/21/2017 (82 FR 14420); Sunset renewal notice effective 10/30/2019 (84 FR 53577); Sunset renewal notice 04/14/2023 (88 FR 22893)
Sunset Date: 05/29/2028

Subcommittee Review

Use
Sodium hypochlorite is an Environmental Protection Agency (EPA)--registered pesticide (PC Code 014703). Sodium hypochlorite in aqueous solution is generally referred to as “bleach.” It is an antimicrobial disinfectant and pesticide used to control harmful microorganisms including bacteria, viruses, and fungi on inanimate objects and surfaces primarily in indoor environments. It is allowed for disinfecting and sanitizing food contact surfaces. Residual chlorine levels for wash water in direct crop or food contact and in flush water from cleaning irrigation systems that is applied to crops or fields cannot exceed the maximum residual disinfectant limit under the Safe Drinking Water Act (currently 4mg/L expressed as Cl_2).

Sodium hypochlorite is an "indirect" food additive approved by Food and Drug Administration (FDA). Sodium hypochlorite may be used as a final sanitizing rinse on food processing equipment (21 CFR 178.1010); sodium hypochlorite may be used in washing and lye peeling of fruits and vegetables (21 CFR 173.315). Sodium hypochlorite also can be used in postharvest, seed, or soil treatment on various fruit and vegetable crops [2006 TR, lines 93-99].

For organic food handling facilities and equipment, chlorine materials may be used up to maximum-labeled rates for disinfecting and sanitizing food contact surfaces. Rinsing is not required unless mandated by the label use directions. Water used in direct post-harvest crop or food contact (including flume water to transport fruits or vegetables, wash water in produce lines, egg or carcass washing) is permitted to contain chlorine materials at levels approved by the FDA or the EPA for such purposes. Rinsing with potable water that does not exceed the maximum residual disinfectant limit for the chlorine material under the SDWA must immediately follow this permitted use. Certified operators should monitor the chlorine level of the final rinse water, the point at which the water last contacts the organic product. The level of chlorine in the final rinse water must meet limits as set forth by the SDWA. Water used as an ingredient in organic food handling should not exceed the maximum residual disinfectant limit for the chlorine material under the SDWA, as required by the Organic Food Production Act (7 U.S.C. 6510(a)(7)).

In water and soil, sodium hypochlorite separates into sodium and hypochlorite ions and hydrochlorous acid molecules. Hypochlorous acid molecules are neutral and small in size. As a result, when hypochlorous acid molecules exist in equilibrium with the hypochlorite ions, they easily diffuse through the cell walls of bacteria. This changes the oxidation-reduction potential of the cell and inactivates triosephosphate dehydrogenase, an enzyme which is essential for the digestion of glucose. Inactivation of this enzyme effectively destroys the microorganism's ability to function [2006 TR, lines 117-122].

Information provided by three NOP-accredited certifying agents revealed that all three certifiers approved chlorine for post-harvest handling. They all approved sodium hypochlorite, acidified sodium chlorite, calcium hypochlorite, chlorine dioxide, and hypochlorous acid generated from electrolyzed water. Sodium hypochlorite was the most commonly used material for post-harvest handling, with calcium hypochlorite and chlorine dioxide also common, according to one certifier.

Manufacture

Generally, sodium hypochlorite is produced by reacting chlorine with a solution of sodium hydroxide (NaOH, also called lye or caustic soda). This method is used for most commercial productions of sodium hypochlorite. A more active, but less stable formulation of sodium hypochlorite can be produced by chlorinating a solution of soda ash (Na_2CO_3) [2006 TR, lines 156-159].

International Acceptance

Canadian General Standards Board Allowed Substances List (CAN/CGSB 32.311-2020)

- The following chlorine compounds are permitted: a) calcium hypochlorite; b) chlorine dioxide; c) hypochlorous acid generated via electrolyzed water; d) sodium hypochlorite. Shall not exceed maximum levels for safe drinking water. Chlorine compounds may be used: a) for wash water in direct contact with crops or food; b) in flush water from cleaning irrigation systems, equipment, storage or transport units—application to crops or fields is permitted (Table 7.3 - Food-grade cleaners, disinfectants and sanitizers permitted without a mandatory removal event, CAN/CGSB-32.311-2020).
- The following chlorine compounds are permitted up to maximum label rates: a) calcium hypochlorite; b) chlorine dioxide; c) hypochlorous acid generated via electrolyzed water; d) sodium hypochlorite (Table 7.4 - Cleaners, disinfectants and sanitizers permitted on organic product contact surfaces for which a removal event is mandatory, CAN/CGSB-32.311-2020).

European Economic Community (EEC) Council Regulation, EC No. 2018/848 and 2021/1165

- Sodium hypochlorite is not explicitly mentioned in the regulations.
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CODEX Alimentarius Commission, Guidelines for the Production, Processing, Labelling and Marketing of Organically Produced Foods (CXG 32-1999)

- Sodium hypochlorite is not explicitly mentioned in the regulations.

International Federation of Organic Agriculture Movements (IFOAM) Norms

- Sodium hypochlorite is permitted with the following limitation: an intervening event or action must occur to eliminate risks of contamination (Appendix 4, Table 2: Indicative list of equipment cleansers and equipment disinfectants, IFOAM NORMS 2014).
- Sodium hypochlorite (e.g., as liquid bleach) is permitted (Appendix 5: Substances for pest and disease control and disinfection in livestock housing and equipment, IFOAM NORMS 2014).

Japan Agricultural Standard (JAS) for Organic Production

- Any substances other than hypochlorous acid water and sodium hypochlorite, both of which are specified in Table D.1, should not be used for the seeds specified in 5.6.1 (Seeds used in cultivation facilities of sprout, JAS 1605 Organic Products of Plant Origin).
- Sodium hypochlorite sodium chloride is permitted with the following criteria: limited to those obtained by electrolyzing the salt solution (limited to those using salt containing no less than 99% sodium chloride) (Table D.1 - Substances for preparation etc., JAS 1605 Organic Products of Plant Origin).
- Sodium hypochlorite is permitted with the following criteria: limited to the use in processed products of plant origin (limited to the use of hypochlorous acid water produced by electrolyzing salt water (limited to the use of salt containing 99% or more sodium chloride)), or the use for disinfecting the intestines of livestock animals for processed meat products, or cleaning of eggs (Table A.1 - Additives for organic processed foods excluding organic alcohol beverages, JAS 1606 Organic Processed Foods).
- Sodium hypochlorite is permitted with the following criteria: limited to the use only for the purpose of disinfecting meat in the process of dismantling or cleaning eggs (Table K.1 - Substances for preparation or other purposes, JAS 1608 Organic Livestock Products).

Human Health and Environmental Issues
Chlorine sanitizing compounds currently on the National List are strong oxidants and can pose serious risks to human health if acute high exposure occurs or from chronic lower-level exposures – especially in occupational environments when these materials are used daily. Chlorine compounds are dermal, respiratory, ocular, and mucous membrane irritants. Sodium hypochlorite (bleach) can cause asthma, as classified by the Association of Occupational and Environmental Clinics. Given the similar chemical properties and mechanisms of action, other chlorine-based oxidant sanitizers are also likely to cause asthma. Chlorine compounds are toxic to fish and other aquatic organisms. Strict adherence to the label is required when used, including the use of personal protective equipment when appropriate. Use of chlorine compounds in organic processing and crop production have been reviewed in the 2006 and 2011 Technical Reports (TR) (referenced above). The EPA exempts calcium hypochlorite (40 CFR 180.1054), potassium hypochlorite (40 CFR 180 1300), and sodium hypochlorite (40 CFR 180.1235) from the requirement of a tolerance in food [2025 TR, lines 446-447].

A laboratory experiment treated soil samples with a sodium hypochlorite solution and a hypochlorous acid solution to measure soil enzyme activity [2025 TR, lines 1280-1288]. Soil samples were treated with commercial disinfectants with low concentrations of 250 mg/L and high concentrations of 500 mg/L of each of the active ingredients. The researchers measured Trihalomethanes (THMs) after 24 hours. Hypochlorous acid generated higher levels of THMs with trichloromethane being the predominant disinfection byproduct. They next measured urease, phosphatase, catalase, and sucrase activity at 7 days and 28 days. Phosphatase showed decreased activity with all treatments. Catalase, which is an oxygen scavenger, increased its activity. Urease activity decreased with the sodium hypochlorite treatments but increased with the low hypochlorous acid treatment. Plant available nitrogen in the form of ammonia is produced by urease activity. Sucrase activity was unchanged [2025 TR, lines 1280-1288].

Discussion
Subcommittee discussions during the sunset review of sodium hypochlorite covered comments from various stakeholders on its essentiality as well as impact on human and environmental health. Below is a summary of discussions and public comments on sodium hypochlorite during its last sunset review. Arguments in support of sodium hypochlorite and other chlorine materials include its use in protecting food from contamination by human pathogens which is essential in safeguarding organic integrity. Despite the potential for significant risks to human health and the environment, chlorine compounds have

been deemed essential to ensure food safety and to comply with food safety regulations under the Food Safety Modernization Act (FSMA). The Crops Subcommittee (CS) generally supported the continued listing of chlorine materials but encouraged ongoing discussion at the time on the listing of sanitizers and disinfectants for post-harvest handling and processing. Some public comments outlined the need for a comprehensive technical review of sanitizers and listing of sanitizers on the National List itemized "by specific use or application" with clear identification of the hazards to humans and the environment. It was said that further restructuring of the National List with a designated category for cleaners, sanitizers and disinfectants would help to ensure certified operations understand which cleaners, sanitizers and disinfectants may be used and would facilitate better organic education.

In the 2025 sunset review of another chlorine material (potassium hypochlorite), the CS received public comments that were not supportive of the proposed annotation requiring the use of chlorine produced using environmentally friendly methods in the synthetic production of chlorine materials. It was stated that this annotation would make it difficult to obtain chlorine materials that meet this requirement.

Questions to our Stakeholders
None

Copper sulfate

Reference: § 205.601(a)(3) Copper sulfate – for use as an algicide in aquatic rice systems, is limited to one application per field during any 24-month period. Application rates are limited to those which do not increase baseline soil test values for copper over a timeframe agreed upon by the producer and accredited certifying agent; and,

§ 205.601(e)(4) Copper sulfate—for use as tadpole shrimp control in aquatic rice production, is limited to one application per field during any 24-month period. Application rates are limited to levels which do not increase baseline soil test values for copper over a timeframe agreed upon by the producer and accredited certifying agent.
Technical Report: 1995 TAP (Copper Sulfate and Other Coppers); 2001 TAP; 2011 TR; 2022 TR
Petition(s): 2001
Past NOSB Actions: 10/2001 meeting minutes and vote; 11/2007 recommendation; 04/2011 recommendation; 10/2016 sunset recommendation; 10/2021 sunset recommendation
Recent Regulatory Background: National List amended 10/31/2003 (68 FR 61987); Sunset renewal notice effective 11/03/2013 (78 FR 61154); Sunset renewal notice effective 11/03/2013; Sunset renewal notice effective 05/29/2018 (83 FR 14347); Sunset renewal notice 04/14/2023 (88 FR 22893)
Sunset Date: 05/29/2028

Subcommittee Review

Use
Copper sulfate is used as an algicide for rice crops, as the growth of algal matting in flooded fields can dislodge young seedlings. It is broadcast aerially into the flooded rice fields by plane. Rice farmers also spray copper sulfate to control a freshwater invertebrate, *Triops longicaudatus*, otherwise known as tadpole shrimp. Tadpole shrimp are only detrimental to very young seedlings, as their burrowing activities can disrupt the seedling roots and the first emerging leaves.

Manufacture

Copper sulfate is manufactured by treating copper metal with hot concentrated sulfuric acid. Copper oxides can be treated with a more dilute sulfuric acid to produce copper sulfate. Copper sulfate is also known as copper vitriol.

International Acceptance

Canadian General Standards Board Allowed Substances List (CAN/CGSB 32.311-2020)

- Copper is permitted as a soil amendment. The following copper products may be used to correct documented copper deficiencies: **copper sulphate**, basic copper sulphate, copper oxide and copper oxysulphate. Copper ammonia base, copper ammonium carbonate, copper nitrate and cuprous chloride are prohibited. Shall be used with caution to prevent excessive copper accumulation in the soil. Copper build-up in soil shall prohibit future use. Visible residue of copper products on harvested crops is prohibited (Table 4.2 - Substances for crop production, CAN/CGSB-32.311-2020).
- Copper is permitted as a production aid. **Copper sulphate**, copper hydroxide, copper octanoate, Bordeaux mix, copper oxychloride and copper oxide. Permitted for use as a wood preservative, or for controlling pests, including diseases. Shall be used with caution to prevent excessive copper accumulation in the soil. Copper build-up in soil shall prohibit future use. Visible residue of copper products on harvested crops is prohibited (Table 4.2 - Substances for crop production, CAN/CGSB-32.311-2020).
- **Copper sulphate** is permitted as an essential nutrient (source of copper and sulphur) and for topical use (foot baths) (Table 5.3 - Health care products and production aids, CAN/CGSB-32.311-2020).

European Economic Community (EEC) Council Regulation, EC No. 2018/848 and 2021/1165

- The following products or products containing the following active substances as listed in Annex VII to Regulation (EC) No 889/2008 cannot be used as biocidal products: caustic soda; caustic potash; oxalic acid; natural essences of plants with the exception of linseed oil, lavender oil and peppermint oil; nitric acid; phosphoric acid; sodium carbonate; **copper sulphate**; potassium permanganate; tea seed cake made of natural camelia seed; humic acid; peroxyacetic acids with the exception of peracetic acid (Annex IV: Authorised products for cleaning and disinfection, EC No. 2021/1165).

CODEX Alimentarius Commission, Guidelines for the Production, Processing, Labelling and Marketing of Organically Produced Foods (CXG 32-1999)

- Copper in the form of copper hydroxide, copper octanoate, copper oxychloride, (tribasic) **copper sulphate**, cuprous oxide, Bordeaux mixture, and Burgundy mixture is permitted with the following conditions for use: need, prescription and application rates recognized by certification body or authority. As a fungicide on condition that the substance be used in such a way as to minimize copper accumulation in the soil (Table 2 - Substances for plant pest and disease control, CXG 32-1999).

International Federation of Organic Agriculture Movements (IFOAM) Norms

- Trace elements (e.g., boric acid; sodium borate; calcium borate; borethanolamin; cobalt-acetate; cobalt-sulphate; copper oxide; **copper sulfate**; copper hydroxide; copper silicate; copper carbonate; copper citrate; ferric oxide; ferric sulfate; ferrous sulfate; iron citrate; iron sulfate; iron tartrate; manganous oxide; manganese sulfate; manganese carbonate; selenic acid; selenous acid; sodium molybdate; molybdic oxide; zinc carbonate; zinc oxide; zinc silicate; and zinc sulfate) are permitted as calcareous and magnesium amendments of mineral origin with the following conditions for use: use restricted to cases where soil/plant nutrient deficiency is documented by soil or tissue testing or diagnosed by an independent expert. Micronutrients in either chloride or nitrate forms are prohibited. Micronutrients may not be used as a defoliant, herbicide, or desiccant (Appendix 2: Fertilizers and soil conditioners, IFOAM NORMS 2014).

[Japan Agricultural Standard (JAS) for Organic Production]

- **Copper sulfate** is permitted with the following criteria: limited to the use for the preparation of Bordeaux mixture (Table B.1 - Agricultural chemicals, JAS 1605 Organic Products of Plant Origin).

Environmental and Human Health Issues

Copper sulfate is readily dissolved and suspended in the water and is lethal to fish and other aquatic organisms at fairly low concentrations. In amphibians, increasing concentrations of copper can alter behavior, reduce growth rates and final size, and at higher concentrations can result in death. Copper also has algicidal effects and can disrupt the food chain in aquatic environments. For this reason, its direct introduction into flooded rice fields is contentious, particularly since rice fields serve as replacement wetlands for many birds and other fauna in agricultural areas like Northern California. Previous comments to the NOSB have highlighted specific concerns that the application rates in organic rice fields in California are several times higher than the amounts known to be toxic to native amphibian species.

In the soil, copper can concentrate heavily in the topsoil and over time, altering the soil microbiota and killing soil-dwelling animals such as earthworms. Copper toxicity in the soil can reduce the growth and nutrient value of crop plants, as well as damage the integrity of root systems (Van Assche and Clijsters, 1990). Because it accumulates in the soil over time and eventually results in poor plant outcomes, its use as a sustainable practice is called into question.

Copper sulfate has been shown to be toxic to bees, particularly in tropical environments. At sub-lethal levels, the heavy metal also changes behavior and movement ability of bees (Rodrigues et al, 2016). Despite this, there are multiples statements on the National Pesticide Information Center (NPIC) and in US Environmental Protection Agency Office of Pesticide Programs documents stating that copper sulfate is virtually non-toxic to bees. This is an important issue to clarify. The role that bees play in the pollination of commercial crops globally should make the use of copper sulfate a concern to farmers and the general public alike.

Copper sulfate has been classified as a human carcinogen by the European Chemicals Agency (ECHA), with specific concern for renal cancers (Buzio et al, 2002). Chronic exposure to fungicidal sprays elevated the risk of renal cancers by almost 3 times. While copper binds to soils readily, copper contamination of drinking water sources would also be a concern.

When copper sulfate is applied to flooded paddies, the copper becomes fixed to soil particles after 7 or more days. Thus this use elevates soil copper levels but does not contaminate other water bodies when the field is drained.

Discussion

Copper sulfate is a difficult substance to evaluate, as there appears to be broad consensus throughout the US, EU, and Canada that it is hazardous to both human health and the environment. Despite this, its use has repeatedly been extended in all three jurisdictions, as there isn't yet a viable organic alternative for copper in certain applications. The EU, Canada, and Japan all exclude copper sulfate for organic rice production but allow it as a fungicidal spray in organic orchards and vineyards.

In terms of copper sulfate use in rice paddies to control tadpole shrimp, it appears that there may be ways to circumvent the need for chemical control. The tadpole shrimp emerge from eggs and most hatch within 1-3 days of flooding. Tadpole shrimp primarily cause injury to the rice through chewing young roots and shoots and disrupting the roots with burrowing activities (Tindall and Fothergill, 2012). The shrimp do not injure older seedlings once they have reached the water surface and roots are well established in the soil.

In fact, at this later stage in seedling development, the tadpole shrimp can be beneficial to the crop by controlling algae and mosquitos.

Transplanting in older seedings eliminates any threat from algal mats to the delicate young seedling stage, as do practices such as dry seeding the rice or ensuring that the rice is seeded directly at the time of flooding. Transplanting seedlings has been the preferred method of rice production throughout most of human rice cultivation but is much more expensive than direct seeding. In Asian rice cultivation, the tadpole shrimp are often deliberately introduced as a means of controlling algae and mosquitos. The current approach of flooding the fields and then direct wet-seeding didn't gain popularity until broad chemical use was implemented and was demonstrated to marginally reduce costs and increase yields.

An important issue for this use of copper sulfate on organic farms is the annotation requirement that, "application rates are limited to those which do not increase baseline soil test values for copper over a timeframe agreed upon by the producer and accredited certifying agent." The 2022 TR indicates that available soil copper levels have been shown to increase dramatically over time in some situations [n 1114-1117, 1210-1223[. While copper is an element and does not break down when added to the soil, it does leave the soil in harvested crops and leachate. In addition, it may be tightly adsorbed to soil particles and not show up on a soil test. Soil test copper levels appear to increase rapidly when multiple heavy applications are used over years. In order to fulfill this requirement, the original soil baseline copper level needs to be compared to current levels by the certifier. While pesticide applications of copper can be a source of increasing soil test copper levels, manure applications can also include even larger amounts of copper [TR ln 2519-2524].

The maximum label application rate for one product (Brandt Copper Sulfate Crystals, 25.1% copper) is 10.88 lb. per acre-foot for algae control and 27.2 lb. per acre foot for tadpole shrimp control. At a typical maximum paddy water depth of 5 inches, this translates to 11.3 lb. of copper sulfate per acre or 2.8 lb. of elemental copper for shrimp control.

A Swiss study showed yearly copper leaching rates of only 2.65 to 11.7 grams per hectare in dryland grain systems, less than an ounce per acre (Wiggenhauser et al., 2024). If these rates are close to what happens in organic rice soil systems, copper will be accumulating over time. Since some of the total copper is strongly held by the soil particles, soil test results will likely not increase as quickly as total soil copper.
It is necessary to research alternate algicides and other means of controlling tadpole shrimp.

It appears that to date there is sufficient evidence to conclude that:

1. Use of copper sulfate in rice fields can cause environmental damage,
2. Alternative seeding practices could eliminate the need for copper sulfate as both algae and tadpole shrimp cease to be problematic once seedlings are established and
3. International standards do not allow spraying of copper sulfate for organic rice production.
4. It is not feasible to apply amounts of copper sulfate that will not raise soil copper levels over time

NOSB Subcommittee Review Much of the Crops Subcommittee's review of copper sulfate centered on public comments and on interviewing stakeholders after the Spring 2021 NOSB meeting. There were in excess of twenty-five written and oral comments with the overwhelming majority in favor of keeping copper sulfate on the National List. Two of the organizations most opposed to the use of copper sulfate did not advocate immediate delisting, but rather, strongly urged the program to: Get serious about "Continuous Improvement" and to put some real effort into finding alternative methods or materials that would limit or end its use.

Questions to our Stakeholders

1. How do certifiers verify compliance with this annotation?
2. Are there practical alternatives for algae and tadpole shrimp management in paddy rice?
3. Are there practical methods to remediate high soil copper levels?
4. What are common organic rice rotations? Is rice ever grown in successive years?
5. If so, is copper sulfate allowed to be applied to rice in successive years, alternating control of algae and tadpole shrimp?

References

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Ozone gas

Reference: § 205.601(a)(5) Ozone gas—for use as an irrigation system cleaner only.
Technical Report: 2002 TAP; 2021 TR
Petition(s): 2001
Past NOSB Actions: 09/2002 meeting minutes and vote; 11/2007 recommendation; 12/2011 recommendation; 10/2016 sunset recommendation; 10/2021 sunset recommendation
Recent Regulatory Background: National List amended 10/31/2003 (68 FR 61987); Sunset renewal notice effective 11/03/2013 (78 FR 61154); Sunset renewal notice effective 05/29/2018 (83 FR 14347); Sunset renewal notice 04/14/2023 (88 FR 22893)
Sunset Date: 05/29/2028

Subcommittee Review

Use
Ozone gas is a strong oxidant and works by oxidizing plant tissue and bacterial membranes. The primary use of ozone globally is as a water treatment. In this capacity, ozone oxidizes organic and inorganic compounds, improving water quality when used as a broad-scope disinfectant. It is used in organic crop production primarily as a sanitizer for water, equipment, and post-harvest handling systems to reduce microbial contamination. It is applied as a processing aid or treatment agent and does not persist in the environment, as it rapidly decomposes to oxygen. Ozone is found in the atmosphere at levels of 0.05 ppm, but at levels of 0.5 ppm in cities with smog.

Manufacture
Ozone occurs naturally, mostly in the upper atmosphere. Naturally occurring ozone is often the product of ultraviolet radiation on atmospheric oxygen. Producers generate most ozone by applying a low-current electrical discharge (corona discharge) to atmospheric oxygen. Increasingly, producers generate ozone through the electrolysis of water. Ozone can also be manufactured photochemically by exposing oxygen in air or water to ultraviolet light. Ozone is an unstable gas in the air and even more so in water, so it must be produced on site.

International Acceptance
Canadian General Standards Board Allowed Substances List (CAN/CGSB 32.311-2020)

- Teat dips and udder wash are permitted. Substances, such as alcohol, iodine, hydrogen peroxide, chlorine dioxide and **ozone**, can be used as disinfectants for a pre- or post-teat dip or udder wash if they are registered for this use by Canada's *Food and Drug Regulations. Chlorhexidine can be used as a post-milking teat dip if alternative germicidal agents and physical barriers have lost their effectiveness* (Table 5.3 - Health care products and production aids, CAN/CGSB-32.311-2020).
- **Ozone** is permitted (Table 6.3 - Ingredients classified as food additives, CAN/CGSB-32.311-2020).
- **Ozone** is permitted (Table 6.5 - Processing aids, CAN/CGSB-32.311-2020).
- **Ozone** is permitted (Table 7.3 - Food-grade cleaners, disinfectants and sanitizers permitted without a mandatory removal event, CAN/CGSB-32.311-2020).

European Economic Community (EEC) Council Regulation, EC No. 2018/848 and 2021/1165

- With regard to disease prevention, the following rules shall apply: (i) ultraviolet light and **ozone** may only be used in hatcheries and nurseries (Disease prevention, EC No. 2018/848).

CODEX Alimentarius Commission, Guidelines for the Production, Processing, Labelling and Marketing of Organically Produced Foods (CXG 32-1999)

- **Ozone** is not explicitly mentioned in the regulations.

International Federation of Organic Agriculture Movements (IFOAM) Norms

- **Ozone** is permitted (Appendix 4, Table 2: Indicative list of equipment cleansers and equipment disinfectants, IFOAM NORMS 2014).

Japan Agricultural Standard (JAS) for Organic Production

- **Ozone** is permitted (Table D.1 - Substances for preparation etc., JAS 1605 Organic Products of Plant Origin).
- **Ozone** is permitted with the following criteria: limited to the use for disinfecting the processed meat products, or cleaning of eggs (Table A.1 - Additives for organic processed foods excluding organic alcohol beverages, JAS 1606 Organic Processed Foods).
- **Ozone** is permitted with the following criteria: limited to the use only for the purpose of disinfecting meat or cleaning eggs (Table K.1 - Substances for preparation or other purposes, JAS 1608 Organic Livestock Products).

Human Health and Environmental Issues
When ozone gas is used for water treatment, it oxidizes or disinfects many components that impact water quality and could result in crop iron deficiencies. It will oxidize iron and manganese, which precipitate as ferric and manganese hydroxides. Ozone partially oxidizes organic matter to forms that are more easily biodegradable. It is also germicidal against many types of pathogenic organisms including viruses, bacteria, and protozoa. It is rated as a strong irritant via inhalation, and is irritating to skin, eyes, and mucous membranes. Exposure to atmospheric ozone generated from on-site production can be minimized through

equipment maintenance. Ozone is Generally Recognized as Safe (GRAS) by the U.S. Food and Drug Administration (FDA) without limitations other than current good manufacturing practices. Ozone systems that inject directly into irrigation lines use relatively low concentrations of ozone and there is little potential for off-gassing. In water, ozone decomposes rapidly and the only decomposition product is oxygen, as opposed to chlorine, which can generate trihalomethanes. Cleaning of irrigation lines should not lead to problems with soil structure because most of the ozone is contained in the irrigation tubing.

Discussion
Ozone is still in active use by the organic community. Public comments during the last sunset review supported relisting ozone, and the Board unanimously approved its relisting.

Questions to our Stakeholders

1. Is ozone gas necessary for organic crop production, and for what specific uses (e.g., water sanitation, post-harvest handling, equipment sanitation)?
2. Are there effective organic alternatives available that could reasonably replace ozone for these uses?

Peracetic acid

Reference: § 205.601(a)(6) Peracetic acid—for use in disinfecting equipment, seed, and asexually propagated planting material. Also permitted in hydrogen peroxide formulations as allowed in § 205.601(a) at concentration of no more than 6% as indicated on the pesticide product label; and,

§ 205.601(i)(8) Peracetic acid - for use to control fire blight bacteria. Also permitted in hydrogen peroxide formulations as allowed in § 205.601(i) at concentration of no more than 6% as indicated on the pesticide product label.
Technical Report: 2000 TAP; 2016 TR
Petition(s): 2008
Past NOSB Actions: 11/2007 recommendation; 11/2009 annotation change; 12/2011 sunset recommendation; 10/2016 sunset recommendation; 10/2021 sunset recommendation
Recent Regulatory Background: National List amended 10/31/2003 (68 FR 61987); Sunset renewal notice effective 10/09/2008 (73 FR 59479); Annotation change 05/28/2013 (78 FR 31815); Sunset renewal notice effective 05/29/2018 (83 FR 14347); Sunset renewal notice 04/14/2023 (88 FR 22893)
Sunset Date: 05/29/2028

Subcommittee Review

Use
In organic crop production, peracetic acid, or PAA, is used to disinfect equipment. It can also be used as a disinfectant to treat seeds or asexually propagated planting material. It can be used to disinfect pruning equipment to help prevent the spread of the fire blight bacterium and is also used in one of the hydrogen peroxide formulations for control on the tree canopy of this same disease (2016 TR, lines 91-98, 731-734). PAA is also used in formulations of hydrogen peroxide, allowed at a concentration of no more than 6%, for use in organic crop production (2016 TR, lines 20-24). Peracetic acid was relisted during the 2016 sunset review for Handling and the 2017 sunset review for Livestock. Peracetic acid is an unstable oxidizing agent, which makes it an effective sanitizer (2016 TR, line 38).

First industrially developed in 1950, it has historically been used to treat fruits and vegetables to reduce spoilage from bacteria and various fungi. It is used to treat bulbs, to disinfect potting soil, clean irrigation equipment, and as a seed treatment to inactivate fungi or other plants diseases. Additionally, in organic crop production, it is also used as a bactericide/fungicide in wash waters to help decrease *Escherichia coli O157:H7* on some fruit and vegetable crops. With the removal of two antibiotics previously allowed for use in organic crop production to assist in fire blight reduction, use of this substance as part of a rotational control and fire blight prevention program has increased in recent years, according to information provided by some organic stakeholders during public comment periods.

Manufacture

According to the 2016 Technical Report (TR), solutions of peracetic acid, hydrogen peroxide, acetic acid, and water are produced by reacting glacial acetic acid with hydrogen peroxide, frequently in the presence of a catalyst such as a mineral acid (e.g., sulfuric acid). Most commercially available PAA solutions contain a synthetic stabilizer and chelating agent such as HEDP (1-hydroxyethylidene-1, 1-diphosphonic acid) or dipicolinic acid (2, 6-dicarboxypyridine) to slow the rate of oxidation or decomposition (2016 TR, lines 46-48, 342-344).

PAA appears to be a straightforward material in that it is made from, and decomposes back to, acetic acid, oxygen, and water. PAA is a very strong oxidizing agent and can be produced by the interaction between methyl (or acetaldehyde) and air, or by mixing acetic acid and hydrogen peroxide (methyl itself derives from plants, commonly coffee, bread grains, and ripe fruit). It can also be produced within laundry detergents and is considered a more effective bleach than hydrogen peroxide.

International Acceptance

Canadian General Standards Board Allowed Substances List (CAN/CGSB 32.311-2020)

- **Peracetic (peroxyacetic) acid** is permitted as a production aid. Formulations of **peracetic acid** may include unreacted residual reagents and catalysts, such as hydrogen peroxide, acetic acid and sulphuric acid. Permitted for: a) pest control; and b) disinfecting and cleaning seeds and plant stock (Table 4.2 - Substances for crop production, CAN/CGSB-32.311-2020).
- **Peracetic (peroxyacetic) acid** is permitted. On food and plants: **peracetic acid** may be used in wash or rinse water. **Peracetic acid** may also be used on food contact surfaces (Table 7.3 - Food-grade cleaners, disinfectants and sanitizers permitted without a mandatory removal event, CAN/CGSB-32.311-2020).

European Economic Community (EEC) Council Regulation, EC No. 2018/848 and 2021/1165

- The following products or products containing the following active substances as listed in Annex VII to Regulation (EC) No 889/2008 cannot be used as biocidal products: caustic soda; caustic potash; oxalic acid; natural essences of plants with the exception of linseed oil, lavender oil and peppermint oil; nitric acid; phosphoric acid; sodium carbonate; copper sulphate; potassium permanganate; tea seed cake made of natural camelia seed; humic acid; **peroxyacetic acids with the exception of peracetic acid** (Annex IV: Authorised products for cleaning and disinfection, EC No. 2021/1165).

CODEX Alimentarius Commission, Guidelines for the Production, Processing, Labelling and Marketing of Organically Produced Foods (CXG 32-1999)

- **Peracetic acid** is not explicitly mentioned in the regulations.

International Federation of Organic Agriculture Movements (IFOAM) Norms

- **Peracetic acid** is permitted (Appendix 4, Table 2: Indicative list of equipment cleansers and equipment disinfectants, IFOAM NORMS 2014).

- Citric, **peracetic acid**, formic, lactic, oxalic and acetic acid are permitted (Appendix 5: Substances for pest and disease control and disinfection in livestock housing and equipment, IFOAM NORMS 2014).

Japan Agricultural Standard (JAS) for Organic Production

- **Peracetic acid** is not explicitly mentioned in the regulations.

Human Health and Environmental Issues
If misused, peracetic acid can irritate eyes, skin, and breathing [2016 TR, lines 683-684].

Discussion
Peracetic acid was registered by the EPA for indoor antimicrobial use in 1985 [2016 TR, lines 382-383]. In the December 2011 NOSB recommendation for the 2013 sunset review of peracetic acid for the two Crops listings at § 205.601(a)(6) and § 205.601(i)(8), the Board clarified the annotation change from the 2009 recommendation and supported it.

The original recommended annotation change was:

§ 205.601(a)(6) Peracetic acid—for use in disinfecting equipment, seed, and asexually propagated planting material. Permitted in hydrogen peroxide formulations at concentration of no more than 5%.

§ 205.601(i)(8) Peracetic acid—for use to control fire blight bacteria. Permitted in hydrogen peroxide formulations at concentrations of no more than 5%.

This annotation was later implemented by the NOP with a slight change. The recommended 5% limit was changed to a 6% limit, based on information provided during public comment stating the recommended 5% limit was too low compared to percentages in use at the time. This point of concern was discussed at the Spring 2011 NOSB meeting, and it was decided that this slight increase in the percentage was necessary to adequately accommodate use rates.

While there does appear to be other materials that could be used as possible alternatives, peracetic acid is selected for use by many organic crop producers for many reasons: it is a strong oxidizing compound, it works well in cold conditions, it does not give off chlorine into the environment, it is used as part of a rotation process in fire blight disease control, and it is the more benign of the sanitizers and disinfectants since it reverts back to acetic acid, oxygen, and water in the environment (2016 TR, lines 600-601). It has also been described as a no-rinse material. This information was provided during public comment and can be found in the 2016 TR.

Concerns about the various forms of peracetic acid mentioned in the 2016 TR were raised during public comment submitted for the Spring 2016 NOSB meeting. The NOSB determined the majority of those other sources (that were raising a concern) would not be allowed for use in organic crop production or other currently allowed uses, as currently shown on the National List. Several commenters mentioned that all sanitizers and disinfectants should be looked at to determine need and to prioritize allowed uses. The NOSB determined this request was outside of the scope of this specific sunset review and would need to be addressed as a separate issue/topic.

Other public comments mentioned that the implementation of the Food Safety Modernization Act (FSMA), which oversees an enhanced approach to food safety at the farm and handling levels, places an even higher degree of necessity in having this material and/or other sanitizers available for use in organic crop production.

There was overwhelming support for the continued listing of peracetic acid for use in organic crop production. While a few commenters took a neutral position, there were no commenters, either during the written or oral public comment periods, that were specifically opposed to the relisting of peracetic acid. Based on the information provided (comments, new TR, etc.), discussion during public comment periods (in-person, webinar, and written), and Subcommittee review and discussion, the NOSB determined this material satisfies the OFPA evaluation criteria and the Crops Subcommittee supported the relisting of peracetic acid. Additionally, peracetic acid was relisted during the 2016 sunset review for Handling and the 2017 sunset review for Livestock.

There is widespread use of peracetic acid by many stakeholders, and it is generally considered to be critical to the sanitizer, cleaner, and disinfectant toolkit as one of the most benign and effective materials available for crop-specific uses. Many certifiers report that it is a sanitizer in increasingly widespread use.

Organic producers consider peracetic acid essential to ensure food safety and compliance with food safety regulations under FSMA. Stakeholders broadly support the need for a comprehensive technical review of sanitizers and listing of sanitizers on the National List itemized “by specific use or application” with clear identification of the hazards to humans and the environment (NOC, 2020). Further, restructuring the National List so that cleaners, sanitizers, and disinfectants have a designated category would help to ensure certified operations understand which cleaners, sanitizers, and disinfectants may be used, and it would facilitate better organic education. Overall, a unique category on the National List could help the NOSB in its review of cleaners, sanitizers, and disinfectants, and it could support the use of alternative, less toxic materials, when their use can meet strict food safety standards (OTA, 2021).

Questions to our Stakeholders
None

Magnesium oxide

Reference: § 205.601(j)(5) Magnesium oxide (CAS # 1309-48-4)—for use only to control the viscosity of a clay suspension agent for humates.
Technical Report(s): 2021 TR
Petition(s): 2013
Past NOSB Actions: 05/2014 NOSB recommendation to add; 10/2021 sunset recommendation
Recent Regulatory Background: Added to NL 12/27/2018 (83 FR 66559); Sunset renewal notice 04/14/2023 (88 FR 22893)
Sunset Date: 05/29/2028

Subcommittee Review

Use
Magnesium oxide (MgO) is a synthetic substance approved for organic crop production to control the viscosity of a clay suspension agent for humates. MgO occurs as the mineral magnesia and in its hydrated form – magnesium hydroxide – as the naturally occurring mineral periclase. Magnesium oxide appears to be a fairly benign compound with a wide range of uses, including as an antacid and laxative (milk of magnesia) and in lots of industrial processes such as in producing cement, abrasive materials, and furnace linings.

MgO is neither a strong acid nor a strong base. Instead, it acts as a buffering agent when in an aqueous solution. Buffering agents are materials that create an effective resistance to change in pH of an aqueous solution when a strong acid or base is added.

Manufacture

Magnesium oxide is a naturally occurring compound that is found in the mineral periclase. There are several manufacturing processes used to produce MgO. However, most commercially available magnesium oxide is formed by calcinating magnesium carbonate-containing minerals (e.g., magnesite, hydro-magnesite) [2021 TR, lines 421-424].

Magnesium can also be sourced from other mineral sources in the form of magnesium chlorides and silicates, which can be converted to magnesium hydroxide via acid-base and metathesis reactions. Magnesium hydroxide sourced as brucite or by the chemical processing of other magnesium-containing minerals is calcined to form magnesium oxide [2021 TR, lines 424-428].

Magnesium oxide is also produced from seawater and salt lake brine sources. While magnesium is a common elemental component of brine, magnesium oxide is not present in brine sources due to its water insolubility. Magnesium chloride is the primary source of magnesium within brine and is converted to magnesium hydroxide using the same reactions used to process mineral sources of magnesium chloride. Additionally, brine may be treated with sulfuric acid to remove carbonates, reducing calcium in the final product. Magnesium oxide from brine is also obtained by calcination of magnesium hydroxide [2021 TR, lines 430-437].

NOP guidelines classify substances produced by the "heating or burning of non-biological matter (e.g., minerals) to cause a chemical reaction" as synthetic (NOP 5033). Based on this classification, all commercial sources of magnesium oxide are considered synthetic, formed by calcination (heating) to liberate carbon dioxide (Equation 3) or water (Equation 8) [2021 TR, lines 440-443].

International Acceptance

Canadian General Standards Board Allowed Substances List (CAN/CGSB 32.311-2020)

- Minerals, trace minerals, and elements are permitted with the following origin/usage conditions: non-synthetic chelated or sulphated minerals. Examples include oyster shell, calcium chloride and **magnesium oxide**. Synthetic nutrient minerals may be used if non-synthetic sources are not commercially available. Minerals from any source are permitted for medical use (Table 5.3 - Health care products and production aids, CAN/CGSB-32.311-2020).

European Economic Community (EEC) Council Regulation, EC No. 2018/848 and 2021/1165

- Crude potassium salt is permitted. The minimum content of nutrients (percentage by weight): 9% K_2O; potassium expressed as water-soluble K2O; **2% MgO**; **magnesium in the form of water-soluble salts, expressed as magnesium oxide** (Annex II: Authorised fertilisers, soil conditioners and nutrients, EC No. 2021/1165).
- **Magnesium oxide** is permitted as a feed material of mineral origin (Annex III: Authorised products and substances for use as feed or in feed production, EC No. 2021/1165).

CODEX Alimentarius Commission, Guidelines for the Production, Processing, Labelling and Marketing of Organically Produced Foods (CXG 32-1999)

- **Magnesium oxide** is not explicitly mentioned in the regulations.

International Federation of Organic Agriculture Movements (IFOAM) Norms

- **Magnesium oxide** is not explicitly mentioned in the regulations.

[Japan Agricultural Standard (JAS) for Organic Production]

- **Magnesium oxide** is not explicitly mentioned in the regulations.

Human Health and Environmental Issues

The 2021 TR states that, at the time of publication, the authors found no studies on magnesium oxide's environmental persistence or toxicity. The insoluble nature of magnesium oxide makes it unlikely to contaminate water systems, and its insolubility results in low bioavailability within terrestrial environments [2021 TR, lines 448-451, 462-463]. Moreover, when used as approved within organic agriculture, magnesium oxide is applied in limited quantities as a viscosity control additive, making environmental contamination unlikely [2021 TR, lines 479-480].

The Code of Federal Regulations (CFR), Title 21, Part 184 (Direct food substances affirmed as generally recognized as safe) lists magnesium oxide at § 184.1431 as an ingredient used in food with no limitation other than current good manufacturing practice and affirms the ingredient as generally recognized as safe (GRAS) as a direct human food ingredient [2021 TR, lines 131-135].

The original petitioner noted that magnesium oxide is safely used in numerous applications for other materials because it is considered non-hazardous, environmentally safe, and non-toxic. Some of the applications include:

- wastewater treatment,
- toxic metal removal,
- adsorption of dyes and excess phosphorus from industrial wastewater,
- odor control,
- treatment of acid mine drainage,
- nontoxic flame retardant for clothing,
- flue gas desulfurization, and
- hazardous spill clean-up.

Magnesium oxide and the hydrated form of magnesium hydroxide have been used safely for over a century as a laxative and antacid (milk of magnesia).

Discussion

This is the second sunset review for magnesium oxide since it was added to the National List. A previous technical report covered its use in livestock production, and in 2021 the NOSB requested and received a technical report specific to its use in crop production. The petition and TR describe magnesium oxide as a material used to modify clays so that humic substances can remain suspended in aqueous solutions without recrystallizing, preventing nozzle plugging and improving the stability and viscosity of liquid humate products.

In 2021 the NOSB reviewed the limited stakeholder comments, but most were generally supportive of maintaining the listing. Commenters affirmed that magnesium oxide is currently used for its petitioned purpose and that humates continue to play an important role in organic agriculture by stimulating biological activity, supporting nutrient cycling, improving soil structure, and enhancing water retention and root development. Stakeholders also reiterated that while several non-synthetic materials—such as dolomitic limestone, wood ash, periclase, brucite, or pelletized humates—are cited as potential alternatives, they are either not commercially available or do not meet the chemical or physical specifications needed to suspend humates in solution.

During the 2021 public discussion, one commenter suggested adding an expiration date for reevaluation of the material, though such a change would require annotation outside of the sunset process. Questions were raised regarding the use of nonsynthetic acids in place of sulfuric acid during manufacturing. Environmental considerations shared during the meeting focused on the use of sulfuric or hydrochloric acid in production, which can release carbon dioxide; however, stakeholders noted that without magnesium oxide, dry humates would likely need to be applied, raising concerns about dust exposure.

Questions to our Stakeholders

1. Are there any commercially available nonsynthetic or less-processed alternatives that can perform the same viscosity-control function for liquid humates as magnesium oxide? If so, please describe their availability, performance, and limitations.
2. Is magnesium oxide still necessary for its currently approved use in organic crop production?

EPA List 3 – Inerts of unknown toxicity

Reference: § 205.601(m)(2) EPA List 3—Inerts of unknown toxicity—for use only in passive pheromone dispensers.
Technical Report: N/A
Petition(s): N/A
Past NOSB Actions: 10/2002 meeting minutes and vote (see pheromones); 11/2007 recommendation; 05/2012 recommendation; 08/2015 recommendation to change annotation at 7 CFR § 205.601(m); 10/2016 sunset recommendation; 10/2021 sunset recommendation
Recent Regulatory Background: National List amended 10/31/2003 (68 FR 61987); Sunset renewal notice effective 10/09/2008 (73 FR 59479); Sunset renewal notice effective 10/03/2013 (78 FR 61154); Sunset renewal notice effective 05/29/2018 (83 FR 14347); Sunset renewal notice 04/14/2023 (88 FR 22893)
Sunset Date: 05/29/2028

Subcommittee Review

Use

The annotation for EPA List 3 inerts limits their use in organic crop production to passive pheromone dispensers. The dispensers are generally manufactured as either tubes that contain pheromones or as an impregnated substance containing the pheromone. Passive pheromone dispensers may be used to trap and monitor insect populations, or they may be used for control of a pest through pheromone mating disruption. For trapping, the pheromone-impregnated dispenser is placed in a trap, and the insect catch is monitored to determine when an economic threshold is reached, and the particular insect needs to be controlled. For pheromone mating disruption, the dispensers are tied to branches of trees or placed in such a manner that they are distributed throughout an area being covered by the pheromones. Throughout the season, the design of the pheromone dispensers regulates the volatilization of pheromones into the air. Once in the air of the production area, the pheromones act to disrupt mating by interfering with the insect communication systems. A wide variety of insects, mostly *Lepidoptera*, can be managed with pheromones including codling moth, peach twig borer, peach crown borer, leafrollers, pink bollworm, boll weevil, gypsy moth, and others. When they are placed in the production area, the pheromone dispensers are not in contact with the organic product being grown but are instead suspended from the trees or plants. Since the pheromone dispensers do not contact the product grown, there is no movement of the pheromones into the product. Passive pheromone dispensers are different from other forms of dispensers such as microencapsulated products, which are sprayed throughout the production area and could be in direct contact with the fruit or other product being grown.

Manufacture

Manufacture varies based on which List 3 inert is being used, so will not be addressed.

International Acceptance

Canadian General Standards Board Allowed Substances List (CAN/CGSB 32.311-2020)

- Formulants used in crop production aids may only be used with substances listed in Column 2 of this table. Only formulants classified as List 4A or 4B by the Pest Management Regulatory Agency (PMRA) or derived from biological or mineral sources may be used with substances in Table 4.2 (Column 2). Formulants classified as **List 3** by PMRA may be used with passive **pheromone dispensers**. Formulants classified as **List 4A, 4B or 3** by PMRA are not subject to 1.4 or 1.5 of CAN/CGSB-32.310. Formulants classified as List 1 or 2 by PMRA are prohibited (Table 4.2 - Substances for crop production, CAN/CGSB-32.311-2020).
- Formulants (**inerts**, excipients) shall be used in conjunction with substances listed in Table 5.3. Formulants are not subject to 1.4 or 1.5 of CAN/CGSB-32.310 or 5.1.2 of this standard (Table 5.3 - Health care products and production aids, CAN/CGSB-32.311-2020).
- Vitamin **formulants** that comply with Canadian regulations are accepted. Vitamins not compliant to 5.1.2 of this standard are permitted. Orally, topically or by injection (Table 5.3 - Health care products and production aids, CAN/CGSB-32.311-2020).
- Formulants may only be used with substances listed in Table 8.2. Only formulants classified as List 4A or 4B by the Pest Management Regulatory Agency (PMRA) or derived from biological or mineral sources may be used with substances in Table 8.2. Formulants classified as **List 3** by PMRA may be used with passive **pheromone dispensers**. Formulants classified as **List 4A, 4B or 3** by PMRA are not subject to 1.4 or 1.5 of CAN/CGSB-32.310. Formulants classified as List 1 or 2 by PMRA are prohibited (Table 8.2 - Facility pest management substances, CAN/CGSB-32.311-2020).
- Formulants may only be used with substances listed in Table 8.3. Only formulants classified as List 4A or 4B by the Pest Management Regulatory Agency (PMRA) or are non-synthetic may be used with substances in Table 8.3. Formulants classified as **List 3** by PMRA may be used with passive **pheromone dispensers**. Formulants classified as **List 4A, 4B or 3** by PMRA are not subject to 1.4 or 1.5 of CAN/CGSB-32.310. Formulants classified as List 1 or 2 by PMRA are prohibited (Table 8.3 - Post-harvest substances, CAN/CGSB-32.311-2020).

European Economic Community (EEC) Council Regulation, EC No. 2018/848 and 2021/1165

- The following products and substances referred to in Article 2(3) of Regulation (EC) No 1107/2009 shall be allowed for use in organic production, provided that they are authorised pursuant to that Regulation: (a) safeners, synergists and **co-formulants** as components of plant protection products (General production rules, EC No. 2018/848).
- In accordance with Article 9(3) of Regulation (EU) 2018/848, safeners, synergists and **co-formulants** as components of plant protection products, and adjuvants that are to be mixed with plant protection products shall be allowed for use in organic production, provided that they are authorised pursuant to Regulation (EC) No 1107/2009. The substances in this Annex may only be used for the control of pests as defined in Article 3(24) of Regulation (EU) 2018/848 (Annex I: Active substances contained in plant protection products authorised for use in organic production, EC No. 2021/1165).
- In relation to products and substances used in traps or in dispensers of products and substances other than **pheromones**, the traps or dispensers shall prevent the products and substances from being released into the environment and shall prevent contact between the products and substances and the crops being cultivated. All traps, including **pheromone traps**, shall be collected after use and shall be safely disposed of (Annex II: Detailed production rules, EC No. 2018/848).
- **Pheromones and other semiochemicals are permitted with the following conditions**: only in traps and dispensers (Annex I: Active substances contained in plant protection products authorised for use in organic production, EC No. 2021/1165).

[CODEX Alimentarius Commission, Guidelines for the Production, Processing, Labelling and Marketing of Organically Produced Foods (CXG 32-1999)]

- The above criteria are intended to be evaluated as a whole in order to protect the integrity of organic production. In addition, the following criteria should be applied in the evaluation process: b) if they are used for the purpose of plant disease or pest and weed control: they should be essential for the control of a harmful organism or a particular disease for which other biological, physical, or plant breeding alternatives and/or effective management practices are not available; and their use should take into account the potential harmful impact on the environment, the ecology (in particular non-target organisms) and the health of consumers, livestock and bees; and substances should be of plant, animal, microbial, or mineral origin and may undergo the following processes: physical (e.g. mechanical, thermal), enzymatic, microbial (e.g. composting, digestion); however, if they are products used, in exceptional circumstances, **in traps and dispensers such as pheromones**, which are chemically synthesized they will be considered for addition to lists if the products are not available in sufficient quantities in their natural form, provided that the conditions for their use do not directly or indirectly result in the presence of residues of the product in the edible parts; their use may be restricted to specific conditions, specific regions or specific commodities (Section 5: Requirements for inclusion of substances in Annex 2 and criteria for the development of lists of substances by countries, CXG 32-1999).
- Pests should be avoided by good manufacturing practice. Pest control measures within storage areas or transport containers may include physical barriers or other treatments such as sound, ultra-sound, light, ultra-violet light, **traps (pheromone traps and static bait traps)**, controlled temperature, controlled atmosphere (carbon dioxide, oxygen, nitrogen), and diatomaceous earth (Handling, Storage, Transportation, Processing and Packaging, CXG 32-1999).
- **Pheromone preparations are permitted in traps** (Table 2 - Substances for plant pest and disease control, CXG 32-1999).

[International Federation of Organic Agriculture Movements (IFOAM) Norms]

- Organic crop production ensures that **co-formulants** (e.g. **inerts** and synergists) in formulated farm input products are not carcinogens, mutagens, teratogens or neurotoxins (Main objectives and detailed requirements of the COROS, IFOAM NORMS 2014).
- **Pheromones – in traps and dispensers only** are permitted (Appendix 3: Crop protectants and growth regulators, IFOAM NORMS 2014).

[Japan Agricultural Standard (JAS) for Organic Production]

- **Sex pheromone agents** are permitted with the following criteria: limited to the agent containing a substance having the pheromone action of insects harmful to crops as the active ingredient (Table B.1 - Agricultural chemicals, JAS 1605 Organic Products of Plant Origin).
- **Pheromone agents** are permitted with the following criteria: limited to chemical agents containing a substance having insect pheromone as the active ingredient; excluding cases in which it is used on plant products for the purpose of controlling pests and diseases (Table C.1 - Chemical agents, JAS 1605 Organic Products of Plant Origin).
- **Pheromones** are permitted with the following criteria: limited to those chemical agents containing substances with insect pheromone actions as the active ingredients; not permitted for use in plant products for controlling pests and diseases (Table C.1 - Chemical agents, JAS 1606 Organic Processed Foods).
- **Pheromones** are permitted with the following criteria: limited to those chemical agents containing a substance with insect pheromone action as the active ingredient; excluding the cases where it is

applied to the plant products for the purpose of controlling pests and diseases (Table B.1 - Chemical agents, JAS 1607 Organic Feed).
- **Pheromones** are permitted with the following criteria: limited to those chemical agents containing a substance with insect pheromone action as the active ingredient; excluding the cases where it is applied to the plant products for the purpose of controlling pests and diseases (Table J.1 - Chemical agents, JAS 1608 Organic Livestock Products).

Human Health and Environmental Issues

Passive pheromone dispensers used to monitor insects are crucial to integrated pest management programs in that they help to determine the size and impact of insect populations. The use of passive pheromone dispensers for mating disruption often precludes the need for other chemical controls. When used with adequate sanitation practices, monitoring, biocontrol methods, and environmental controls, pheromones can be effective in controlling certain *Lepidoptera* insects. Without pheromone use, and despite the other natural controls listed, insecticides may be needed for control of a specific pest insect. Insecticides may either be natural or synthetic, but would most often be applied directly to the product being grown and might require preharvest intervals. While pheromones are very specific to individual insect species, other insecticides may be broader spectrum and affect more species than those requiring control and may have more detrimental environmental impacts.

Other potential environmental issues relate to the number of pheromone dispensers containing List 3 inerts used per acre. Often, maximum applications are in the range of 400 dispensers per acre. Information from the package of one manufacturer lists 8% other ingredients which may include List 3 inerts, and that the total amount of pheromone applied per acres is 50 grams. Given the small amount of pheromone applied, there is a very small volume of List 3 inerts applied to any given acre. This application rate is very low when compared to the amounts of allowed List 4 inerts applied in spray materials or the number of synthetics applied in allowed newspaper mulch. While application of any material to organic acreage should be considered, it is also important to consider the scale of the application. In addition, the ingredients other than pheromones are heavier than the pheromone itself and remain inside the dispenser. Thus, the List 3 inerts are not dispersed into the atmosphere and do not have direct crop contact. The manufacture of pheromones may have possible environmental impacts, but because these materials are grouped together as List 3 inerts, these impacts cannot be independently categorized.

Discussion

For reference, the old EPA lists can be found at: https://www.epa.gov/pesticide-registration/categorized-lists-inert-ingredients-old-lists.

As noted in the 2020 review of List 4 inerts, the List 3 inerts listing is also outdated because EPA no longer maintains these lists. Thus, the process to review materials for addition or removal is broken. The listing for List 3 inerts is more specific than that for List 4 inerts in that it is limited to only those materials needed for and used in passive pheromone dispensers. These dispensers do not come into direct contact with the agricultural products being produced, whether they are used for trapping or mating disruption.

At the Fall 2024 NOSB meeting, the Board passed a recommendation to NOP modernizing the listing for inert substances used in organic pesticide formulations. The proposal provided NOP with two options:

1. Allow all inert ingredients that are exempt from the requirement for a tolerance.
2. List inert ingredients currently allowed in pesticide products individually.

The substances used in passive pheromone dispensers that are found on List 3 are included in both of these options. NOSB does not anticipate any disruptions to the allowance of pheromone products when NOP pursues rulemaking using either of these options. As the organic industry awaits rulemaking action on inert ingredients used in organic pesticide products, the existing allowances will be maintained to ensure there are no disruptions to the availability of passive pheromone products for organic farmers.

Questions to our Stakeholders
None

Calcium chloride

Reference: § 205.602(c) Calcium chloride, brine process is natural and prohibited for use except as a foliar spray to treat a physiological disorder associated with calcium uptake.
Technical Report: 2001 TAP; 2021 TR
Petition(s): 2005; 2015
Past NOSB Actions: 09/1996 minutes and vote; 11/2006 annotation change (failed); 11/2007 sunset recommendation; 12/2011 sunset recommendation; 10/2016 sunset recommendation; 10/2021 sunset recommendation
Recent Regulatory Background: National List amended 10/31/2003 (68 FR 61987); Sunset renewal notice effective 11/03/2013 (78 FR 61154); Sunset renewal notice effective 05/29/2018 (83 FR 14347); Sunset renewal notice 04/14/2023 (88 FR 22893)
Sunset Date: 05/29/2028

Subcommittee Review

Use
Calcium chloride is used to manage almost three dozen physiological disorders on crops. These include reduction of cork spot on pears, bitter pit in apples, fruit cracking on developing figs, rain cracking in cherries, blossom end rot on tomatoes, and tipburn on Chinese cabbage [2001 TAP, lines 156-175]. Application of foliar calcium sprays relieves calcium physiological disorders because these are local deficiencies due to calcium transport problems. Local availability of calcium in new shoots and fruits can help solve the problem [2001 TAP, lines 197-198]. Application of nonsynthetic calcium chloride in organic crop production is limited to foliar sprays to treat a physiological disorder associated with calcium uptake.

Manufacture
According to the 2001 TAP, calcium chloride can be produced from a number of sources by various methods. Some of these are naturally occurring, some require extraction and beneficiation that is not considered by most reviewers to be a chemical reaction, and some are entirely synthetic. Calcium chloride extracted from brine is generally considered nonsynthetic, although certain steps to purify the brine may be considered synthetic [2001 TAP, lines 8-11]. The TAP goes on to explain that calcium chloride can be obtained by extraction of nonsynthetic brines. When calcium chloride is extracted from a nonsynthetic source, its molecular structure is not changed during extraction and thus should be classified nonsynthetic. However, Dow (a major supplier) and other producers use synthetic chemicals during the purification of the brine [2001 TAP, lines 62-64]. Industrial production of calcium chloride occurs mainly through 1) the hydrochloric acid method, 2) the Solvay process, and 3) the Dow process. Productions by the Solvay process and by reaction of a calcium source with hydrochloric acid are both clearly synthetic [2001 TAP, lines 11-12].
Calcium chloride from naturally occurring brine is nonsynthetic as long as there are no manufacturing steps (see NOP 5033: 4.6 Extraction of Nonorganic Materials) that change the classification to synthetic.

International Acceptance
Canadian General Standards Board Allowed Substances List (CAN/CGSB 32.311-2020)

- **Calcium chloride** derived from naturally occurring brines and not chemically treated is permitted (Table 4.2 - Substances for crop production, CAN/CGSB-32.311-2020).
- Sodium chloride, **calcium chloride** or potassium chloride; shall be mined or derived from sources of natural brine. The effluent from ion exchange water softener regeneration may be used. For pest control (Table 4.2 - Substances for crop production, CAN/CGSB-32.311-2020).
- Minerals, trace minerals, and elements are permitted with the following origin/usage conditions: non-synthetic chelated or sulphated minerals. Examples include oyster shell, **calcium chloride** and magnesium oxide. Synthetic nutrient minerals may be used if non-synthetic sources are not commercially available. Minerals from any source are permitted for medical use (Table 5.3 - Health care products and production aids, CAN/CGSB-32.311-2020).
- **Calcium chloride** is permitted for: a) milk products; b) fat products; c) soybean products; and d) fruits and vegetables (Table 6.3 - Ingredients classified as food additives, CAN/CGSB-32.311-2020).

European Economic Community (EEC) Council Regulation, EC No. 2018/848 and 2021/1165

- **Calcium chloride** solution is permitted only for foliar treatment of apple trees, to prevent deficit of calcium (Annex II: Authorised fertilisers, soil conditioners and nutrients, EC No. 2021/1165).
- **Calcium chloride** is permitted for addition to milk-based products as a coagulation agent (Annex V: Authorised products and substances for use in the production of processed organic food and of yeast used as food or feed, EC No. 2021/1165).
- **Calcium chloride** is only authorised for the processing of products of plant origin and sausages based on meat as a coagulation agent (Annex V: Authorised products and substances for use in the production of processed organic food and of yeast used as food or feed, EC No. 2021/1165).
- **Calcium chloride** is permitted as a processing aid in primary yeast (Annex V: Authorised products and substances for use in the production of processed organic food and of yeast used as food or feed, EC No. 2021/1165).

CODEX Alimentarius Commission, Guidelines for the Production, Processing, Labelling and Marketing of Organically Produced Foods (CXG 32-1999)

- **Calcium chloride solutions** are permitted for leaf treatment in case of proven calcium deficiency (Table 1 - Substances for use in soil fertilizing and conditioning, CXG 32-1999).
- **Calcium chloride** is permitted for use in foods of plant origin (fruits and vegetables including mushrooms and fungi, roots and tubers, pulses and legumes, and aloe vera; seaweeds; nuts and seeds; soybean products excluding soybean products of food category 12.9 and fermented soybean products of food category 12.10; soybean protein products; fermented soybean products) and foods of animal origin (dairy products and analogues excluding products of food category 02.008.2; processed meat, poultry, and game products in whole pieces or cuts; processed comminuted meat, poultry and game products; edible casings (e.g., sausage casings)) (Table 3 - Ingredients of non-agricultural origin, CXG 32-1999).
- **Calcium chloride** is permitted for use in plant products as a coagulation agent (Table 4 - Processing aids which may be used for the preparation of products of agricultural origin, CXG 32-1999).
- **Calcium chloride** is permitted for use in livestock and bee products as a firming, coagulation agent in cheese making (For livestock and bee products, CXG 32-1999).

International Federation of Organic Agriculture Movements (IFOAM) Norms

- Limestone, gypsum, marl, maerl, chalk, sugar beet lime, **calcium chloride** are permitted as calcareous and magnesium amendments of mineral origin (Appendix 2: Fertilizers and soil conditioners, IFOAM NORMS 2014).
- Chloride of lime (**calcium chloride**) is permitted (Appendix 3: Crop protectants and growth regulators, IFOAM NORMS 2014).

- **Calcium chloride** is permitted as an additive and as a processing and post-harvest handling aid (Appendix 4, Table 1: List of approved additives and processing/postharvest handling aids, IFOAM NORMS 2014).
- Chloride of lime (calcium oxychloride, **calcium chloride**, and calcium hydroxide) is permitted (Appendix 4, Table 2: Indicative list of equipment cleansers and equipment disinfectants, IFOAM NORMS 2014).

Japan Agricultural Standard (JAS) for Organic Production

- **Calcium chloride** is permitted (Table A.1 - Fertilizers and soil improvement substances, JAS 1605 Organic Products of Plant Origin).
- **Calcium chloride** is permitted with the following criteria: limited to the use in processed products of plant origin (as a coagulant) and in cheesemaking (as a coagulant), or the use in edible fats & oils, processed vegetable products, processed fruit products, prepared legumes/beans, dairy products, or processed meat products (Table A.1 - Additives for organic processed foods excluding organic alcohol beverages, JAS 1606 Organic Processed Foods).
- **Calcium chloride** is permitted (Table B.1 - Additives for alcohol beverages, JAS 1606 Organic Processed Foods).

Human Health and Environmental Issues

The 2001 TAP describes that, when used as a foliar spray, calcium chloride probably has low potential for interaction or interference with other materials used in organic farming [2001 TAP, lines 295-296]. It has a low toxicity to mammals, though it can be a skin, eye, and breathing irritant. When used in foliar applications, it should not affect beneficial insects. It should not persist on foliage and any amount not absorbed by the plant should be washed off with rain. Calcium chloride is extremely soluble in water, and low concentrations from foliar use should not build up in soil, unless it is used in low rainfall areas with minimal irrigation. Any water-soluble calcium chloride not absorbed by plant roots would drain into surface waters or be leached into groundwater [2001 TAP, lines 300-308]. Additionally, during manufacture from brines, the liquid brines are pumped out from underground, and do not present the kind of problem usually seen with strip mining. The only toxic chemicals involved are chlorine and bromine, and they are handled so that environmental contamination is low. The chlorine is recycled, and bromine is isolated as bromide or bromine and is sold as a chemical product. Excess lime added in processing is isolated as part of the final calcium chloride. The magnesium hydroxide produced is used to prepare other magnesium salts and magnesium metal by electrolysis. It is not dumped into the environment. The sodium chloride isolated in the process is sold as table salt or for chemical production. Spent solutions are recycled and pumped back underground to isolate a new concentrated brine [2001 TAP, lines 311-319]. Finally, calcium chloride obtained from natural salt brines has a significant amount of sodium chloride, usually about 3-4%. Sodium chloride has a high salt index and should not be applied to soil. Application to soil could lead to chloride phytotoxicity [2001 TAP, lines 355-358].

Discussion

This is a unique § 205.602 material in that, while not completely prohibited for use, is restricted via an annotation. Since it is only allowed for a very specific use (foliar application to treat a calcium uptake disorder), material review organizations list it with the restriction to reflect the very narrow permitted use. Certifiers are responsible for verifying that growers use it in a manner consistent with the restriction.

In 1996, the NOSB originally voted to allow calcium chloride for use to control bitter pit in apples and as an emergency defoliant for cotton; the material was categorized as nonsynthetic and was not included in sections § 205.601 or § 205.602. In 2003, calcium chloride was subsequently added to National List at § 205.602 as a non-synthetic substance prohibited for use in organic crop production with the current annotation: “brine process is natural and prohibited for use except as a foliar spray to treat a physiological disorder associated with calcium uptake.” In 2005, the NOSB rejected a petition to remove the prohibition for use as a soil-applied non-synthetic substance due to high chloride and solubility concerns. The Board received another petition in 2015 to remove the prohibition on direct soil applications but determined it to be ineligible as no new substantive information was presented to warrant reconsideration of the petition.

The NOSB has consistently concluded that brine process calcium chloride is a mined substance of high solubility, and, as such, its use is subject to the conditions established on the National List of non-synthetic materials prohibited for crop production. The foundational principle for placing high solubility materials such as calcium chloride on the prohibited non-synthetic materials list is described in § 205.203(d) – Soil fertility and crop nutrient management practice standard: A producer may manage crop nutrients...in a manner that does not contribute to contamination of crops, soil, or water by plant nutrients. The NOSB has established that the potential for overuse of this natural substance resulting in subsoil, surface water, and ground water contamination warrant continued limitation through the annotation restrictions.

Relisting calcium chloride as a restricted non-synthetic material was widely supported in previous public comments. Calcium chloride is a material needed to combat physiological disorders of many commodities that typically cannot be resolved with other calcium products. Many previous commenters stated that calcium chloride is necessary to ensure quality of many crops and significant losses would occur if the substance were not relisted. The current annotation restricting the use to foliar sprays to treat a physiological disorder associated with calcium uptake is also supported to prevent soil buildup of chloride.

Questions to our Stakeholders
None

Rotenone

Reference: § 205.602(f) Rotenone (CAS # 83-79-4).
Technical Report(s): N/A
Petition(s): N/A
Past NOSB Actions: 10/2012 NOSB recommendation to add; 10/2021 sunset recommendation
Recent Regulatory Background: Added to NL 12/27/2018 (83 FR 66559); Sunset renewal notice 04/14/2023 (88 FR 22893)
Sunset Date: 05/29/2028

Subcommittee Review

Use
Rotenone is a potent non-synthetic botanical pesticide that is also used as a piscicide. Historically, farmers have used this extract as a foliar spray to control pests on vegetables, berries, tree fruit, nuts, and forage crops.

Manufacture
Rotenone is commonly derived from the roots of various tropical plants native to Southeast Asia, South America, and East Africa.

International Acceptance
Canadian General Standards Board Allowed Substances List (CAN/CGSB 32.311-2020)

- **Rotenone** is not explicitly mentioned in the regulations.

European Economic Community (EEC) Council Regulation, EC No. 2018/848 and 2021/1165

- **Rotenone** is not explicitly mentioned in the regulations.

CODEX Alimentarius Commission, Guidelines for the Production, Processing, Labelling and Marketing of Organically Produced Foods (CXG 32-1999)

- Preparations of **rotenone** from *Derris elliptica, Lonchocarpus,* and *Thephrosia* spp. are permitted with the following conditions for use: Need recognized by the certification body or authority. The substance should be used in such a way as to prevent its flowing into waterways (Table 2 - Substances for plant pest and disease control, CXG 32-1999).

International Federation of Organic Agriculture Movements (IFOAM) Norms

- **Rotenone** (*Derris elliptica, Lonchocarpus* spp. *Tephrosia* spp.) is permitted with the following conditions for use: not near waterways. Subject to approval by the CB (Appendix 3: Crop protectants and growth regulators, IFOAM NORMS 2014).

Japan Agricultural Standard (JAS) for Organic Production

- **Rotenone** is not explicitly mentioned in the regulations.

Human Health and Environmental Issues

Adverse health effects from rotenone have been well documented since the NOSB reviewed botanicals in 1994. In 2004, the EPA required an inhalation neurotoxicity study to investigate the possibility of rotenone leading to Parkinson's Disease-like symptoms at high-dose exposure in animals. Instead, the companies distributing and selling rotenone products voluntarily cancelled all food-use registrations, except for piscicidal uses.

Discussion

Rotenone is found to have adverse environmental and health impacts, a lack of essentiality, and an incompatibility with organic principles. Therefore, the NOSB unanimously passed a recommendation in October 2012 to add rotenone to the National List at § 205.602 as a non-synthetic substance prohibited for use in organic crop production.

During the last sunset review of rotenone, public comments also supported the continued listing as a prohibited natural substance in organic crop production. The Board unanimously voted to maintain the rotenone listing on § 205.602.

Questions to our Stakeholders

None