

**National Organic Standards Board**  
**Crops Subcommittee Petitioned Material Proposal**  
**Carbon Dioxide**  
**July 5, 2022**

**Summary of [Petition](#):**

The NOSB received a petition requesting the addition of synthetic carbon dioxide (CO<sub>2</sub>) at § 205.601 Synthetic substances allowed for use in organic crop production as (a) algicide, disinfectants, and sanitizer, including irrigation system cleaning systems and (j) As plant or soil amendments.

Carbon dioxide is currently allowed for use as an ingredient in organic labeled processed food products: § 205.605 Nonagricultural (nonorganic) substances allowed as ingredients in or on processed products labeled as “organic” or “made with organic (specified ingredients or food group(s)).” (b) Synthetic allowed: - Carbon dioxide. This petition requests the allowance of carbon dioxide in organic crop production under the two sections listed above.

**Subcommittee Review:**

Carbon dioxide is understood to be a material with inherently low risk and is approved as a processing aid. Nonsynthetic sources are not available due to lack of infrastructure at ethanol plants. Because the petitioned material is synthetic, the Crops Subcommittee discussions focused on the need and benefits of using carbon dioxide over other allowed alternatives.

Some farming areas have alkaline water sources that can hinder nutrient availability and optimal crop growing conditions. Currently, organic farmers can use citric acid and sulfur burners to acidify irrigation water. It is a naturally occurring substance in the atmosphere and has no apparent negative effect on other materials used in organic farming systems. In a greenhouse environment, atmospheric CO<sub>2</sub> levels are depleted quickly as it is required for plants to photosynthesize. Greenhouse operations may have limiting levels of carbon dioxide and may benefit from this material as a plant and soil amendment. The Crops Subcommittee questions the potential uses of this material in other growing systems. Previous commenters have also shown interest in further information for this listing. The Crops Subcommittee understands that this product is inherently low risk and is a suitable alternative to current water acidifiers at § 205.601(a).

However, the Crops Subcommittee is seeking more information about the requested use at § 205.601(j) and has requested a limited-scope Technical Report (TR) to understand the use frequency, the application rates, and all methods of applications.

**Category 1: Classification**

1. For CROP use: Is the substance \_\_\_\_\_ **Non-synthetic** or \_\_\_X\_\_\_ **Synthetic**?  
Is the substance formulated or manufactured by a process that chemically changes a substance extracted from naturally occurring plant, animal, or mineral sources? [OFPA §6502(21)] If so, describe, using [NOP 5033-1](#) as a guide.

Carbon dioxide (empirical formula CO<sub>2</sub>, CAS Reg. No. 124-38-9) occurs as a colorless, odorless, noncombustible gas at normal temperatures and pressures. The solid form, “dry ice”, sublimates under atmospheric pressure at a temperature of –78.5 °C.

Carbon dioxide is prepared as a byproduct of the manufacture of lime during the “burning” of limestone, from the combustion of carbonaceous material, from fermentation processes, and from gases found in certain natural springs and wells.

2. Reference to appropriate [OFPA](#) category:

Is the substance used in production, and does it contain an active synthetic ingredient in the following categories: [§6517(c)(1)(B)(i)]; copper and sulfur compounds; toxins derived from bacteria; pheromones, soaps, horticultural oils, fish emulsions, treated seed, vitamins and minerals; livestock parasiticides and medicines and production aids including netting, tree wraps and seals, insect traps, sticky barriers, row covers, and equipment cleansers; or (ii) is used in production and contains synthetic inert ingredients that are not classified by the Administrator of the Environmental Protection Agency as inerts of toxicological concern?

Carbon dioxide falls under the category of production aid.

### Category 2: Adverse Impacts

3. What is the potential for the substance to have detrimental chemical interactions with other materials used in organic farming systems? [§6518(m)(1)]

Carbon dioxide is already allowed as an organic processing substance. It occurs naturally in the atmosphere, has little chemical interactions with other substances, and has no apparent negative effect on other materials used in organic farming systems.

4. What is the toxicity and mode of action of the substance and of its breakdown products or any contaminants, and their persistence and areas of concentration in the environment? [§6518(m)(2)]

The action to dissolve carbon dioxide (CO<sub>2</sub>) in water (H<sub>2</sub>O) makes carbonic acid (H<sub>2</sub>CO<sub>3</sub>): H<sub>2</sub>O + CO<sub>2</sub> -> H<sub>2</sub>CO<sub>3</sub>. Carbonic acid is dissociated in water to: HCO<sub>3</sub><sup>-</sup> + H<sup>+</sup>. This hydrogen lowers water pH. This is a common, naturally occurring reaction in the soil ecosystem from carbon dioxide in the atmosphere.

In soils with high pH, applying water with a reduced pH can increase nutrient availability and increase plant health. Additionally, the activity of carbon dioxide in water can help prevent clogging of irrigation systems by algae and other plant contaminants.

Carbon dioxide can also be used for pest control in storage areas, however, that is not the subject of this petition.

5. Describe the probability of environmental contamination during manufacture, use, misuse, or disposal of such substance? [§6518(m)(3)]

As a basic component of the atmosphere, carbon dioxide has a high environmental persistence. This is not a negative, except to the overarching concern of global warming. At the rates occurring in the atmosphere, it is completely non-toxic and is exempt from having a lethal dose. The water pH adjustment process can be manually controlled, as well as automatically controlled, by adding a pH probe and controller that adjusts the carbon dioxide injection to maintain target pH values in the water. Water cannot drop below pH 5.0 when carbonic acid (dissolved CO<sub>2</sub>) is used in the acidification process.

This characteristic makes the use of carbonic acid the safer and most secure process for water pH adjustment when compared to alternatives.

6. Discuss the effect of the substance on human health. [§6517(c)(1)(A)(i); §6517(c)(2)(A)(i); §6518(m)(4)].

Suffocation can occur in pure carbon dioxide but is due to the lack of oxygen, not toxicity of carbon dioxide. There are no other direct effects on human health from the substance.

7. Discuss any effects the substance may have on biological and chemical interactions in the agroecosystem, including the physiological effects of the substance on soil organisms (including the salt index and solubility of the soil), crops and livestock. [§6518(m)(5)]

The use of dissolved carbon dioxide to reduce water pH is an acidifying method that occurs naturally, i.e., atmospheric carbon dioxide from biological processes enters water through equilibrium. Carbon dioxide dissolves in water, including water in soil solution, to form carbonic acid. Carbonic acid breaks down into carbon dioxide.

8. Are there any adverse impacts on biodiversity? (§205.200)

Carbon dioxide is a greenhouse gas and can contribute to climate change. Its increase in the atmosphere has altered the biodiversity in many ecosystems. However, the use of this product in accordance with the petition will not add to the increase of carbon dioxide. The petitioned use is for carbon dioxide produced as a byproduct of other processes. The carbon dioxide would be released to the atmosphere regardless of the petitioned use.

### **Category 3: Alternatives/Compatibility**

9. Are there alternatives to using the substance? Evaluate alternative practices as well as nonsynthetic and synthetic available materials. [§6518(m)(6)]

Alternatives used in organic production to lower pH levels in irrigation water are sulfur burners and citric acid. Because water pH cannot drop below 5.0 when carbon dioxide is used as an acidifier, this method may be considered more secure as a pH adjustment compared to alternatives.

Sulfur burners create sulfurous acid by dissolving the fumes of burning sulfur in irrigation water. Pure sulfur is an odorless, tasteless, light-yellow solid usually sold in blocks or pellets. Sulfurous acid is slightly irritating to the skin, and strongly irritating to the eyes of rabbits. Under acidic conditions, sulfurous acid may liberate sulfur dioxide, which is known to induce respiratory irritation in humans.

Citric acid is a non-synthetic substance widely used in food processing. It is used as an ingredient, acidulant, pH control agent, flavoring, and sequestrant. It is also used as a dispersant in flavor or color additives. Citric acid is listed as GRAS (Generally Recognized As Safe) by the FDA.

As a plant and soil amendment, there are no substitutions to carbon dioxide since carbon dioxide is needed for photosynthesis. In greenhouse conditions, carbon dioxide can be a limiting resource and its replacement would be needed.

10. In balancing the responses to the criteria above, is the substance compatible with a system of sustainable agriculture? [§6518(m)(7)].

Because carbon dioxide is approved as an organic processing substance, is already being produced, and its listing at § 205.601(a) would be considered a recycling process, the Crops Subcommittee finds it compatible with a system of sustainable agriculture.

The Crops Subcommittee is seeking additional information about the requested use at § 205.601(j) and will develop a proposal for a future NOSB meeting.

**National List Motion:**

Motion to add carbon dioxide at § 205.601(a) algicide, disinfectants, and sanitizer, including irrigation system cleaning systems

Motion by: Logan Petrey

Seconded by: Rick Greenwood

Yes: 6 No: 0 Abstain: 0 Recuse: 0 Absent: 2