

**National Organic Standards Board  
Crops Subcommittee  
Petitioned Material Proposal  
Sulfur as Slug and Snail Bait  
February 20, 2018**

**Summary of Sulfur as a Molluscicide [Petition](#):**

OR CAL, Inc. has petitioned for inclusion of sulfur as a synthetic substance allowed for use in organic crop production under Section 205.601(h) of the National Organic Program's (NOP) National List of Allowed and Prohibited Substances, as a slug and snail bait.

The petition notes that elemental sulfur is currently NOP Listed under section 205.601(e)(5) as an insecticide (including acaricide or miticide), 205.601(i) as a plant disease control, and 205.601(j)(2) as a plant or soil amendment. The NOSB also recommended (Fall 2017) the addition of elemental sulfur to the National List for use as a pesticide on domestic livestock (petitioner: Georgia Gulf Sulfur Corporation of Valdosta, Georgia).

Many stakeholders have experience with sulfur use in organic agriculture and extensive information is available. The petition provides EPA registration information and pesticide label requirements. The petition relies on the [March 2017 Sulfur Livestock technical report](#) for background information. In the original [1995 technical advisory panel \(TAP\) review](#), the reviewers found elemental sulfur to be relatively innocuous in the environment when used according to the product use label. It was also found to be of low toxicity. It should not be used within one month of any horticultural oil product, as currently stated on most sulfur labels. An updated draft Technical Report (TR) for sulfur has been completed and reviewed by the NOSB Crops Subcommittee (anticipated publication on [NOP website](#) March/April 2017). Based on review of the draft Sulfur TR, no new information is likely to change the information available for this proposed use as a molluscicide. Overall, sulfur is considered a low toxicity/low risk material. It is a known respiratory and eye irritant and causes dermatitis. Direct exposures to farm workers can be mitigated if label recommendations and proper personal protective equipment (PPE) recommendations are followed. New research suggests associations with agricultural field applications and poorer respiratory function in children living in agricultural communities. The pellet formulation of the proposed use will likely minimize eye, skin, or respiratory exposures, but these exposures should be evaluated by applicators. Any adverse exposures incidents should be reported to local pesticide regulatory agencies and the NOSB.

**Summary of Review:**

The Crops Subcommittee reviewed extensive information about sulfur used in organic agriculture, including the TR for sulfur use on livestock, the draft TR for elemental sulfur, the petitioner's request, and other scientific information. As organic farmers have worked to reduce tillage, slugs have emerged as a serious pest in organic matter rich soils, particularly when that organic matter is largely left on the soil surface. New tools addressing these pests are needed. This product address a key concern when farmers find that slugs have emerged as a serious pest in organic matter rich soils (Peigne et al. 2007: <http://onlinelibrary.wiley.com/doi/10.1111/j.1475-2743.2006.00082.x/full>). Sulfur has a long history of use in organic farming and is minimally toxic to humans and the environment. Sulfur is an ocular, respiratory, and dermal irritant. However the proposed use under this petition is unlikely to result in adverse exposures to farmers, workers, and surrounding communities. Appropriate protections should be used as needed.

## International Standards:

Internationally approved for use by: The E.U., IFOAM. Codex Alimentarius Commission (CAC GL 32-1999) permits the use of sulfur for pest and disease control when the certification body or authority recognizes the need for plant protection (Codex, 2013). Also allowed by Canadian Organic Standards.

The Canadian General Standards Board (CGSB) includes non-synthetic elemental sulfur as a permitted substance for organic production systems (CAN/CGSB-32.311-2015) for use as a soil amendment and as a foliar application. Chemically synthesized substances cannot be added, and chemical treatment is prohibited. The CGSB also permits the use of sulfur for the control of external parasites and sulfur smoke bombs in conjunction with other methods used for rodent control when a pest control program is temporarily overwhelmed.

The Codex Alimentarius Commission's "Guidelines for the Production, Processing, Labelling, and Marketing of Organically Produced Foods" (GL 32-1999) lists elemental sulfur as an allowed substance for pest and disease control.

The European Economic Community (EEC) Council Regulation (EEC No 2092/91) and carried over by Article 16(3)(c) of Regulation No 834/2007, permits the use of sulfur as a fungicide, acaricide, and repellent in organic food production.

The Japan Agricultural Standard (JAS) for Organic Production (Notification No. 1605 of 2005) permits the use of sulfur as a fertilizer or soil improvement substance, and as a substance for plant pest and disease control.

The International Federation of Organic Agriculture Movement's (IFOAM) lists sulfur as an approved substance for pest and disease control, for use as fertilizer/soil conditioner, and for use as a crop protectant and growth regulator.

## 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.

Elemental sulfur can come either from a natural mined source, or may be produced as a by-product from natural gas or petroleum operations and refinery process. The latter appears to be the primary source of most elemental sulfur currently being used. Because the sulfur is chemically extracted from fossil-fuel feedstock, it is considered synthetic.

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 inert of toxicological concern?

Sulfur is a sulfur compound and falls under §6517(c)(1)(B)(i). As summarized in the draft TR, Sulfur is currently registered for use under the U.S. Environmental Protection Agency's (EPA) Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) Section 3 as an insecticide and fungicide on a wide range of field and greenhouse-grown food and feed crops, livestock (and livestock quarters), and indoor and outdoor residential sites. Use sites include tree fruit, berries, vegetables, root crops, field crops, pets (dogs), ornamentals, and turf (including residential lawns and golf courses).

## Category 2: Adverse Impacts

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

Sulfur is a naturally occurring element, and essential nutrient for plants, and part of normal animal biology. As noted in the draft TR, "the major environmental concern with elemental sulfur is that upon oxidation it forms sulfuric acid, which can acidify soil or water ecosystems. In soil management systems, elemental sulfur is a common soil amendment used to acidify calcareous soil and increase the sulfur fertility; it is expected to have a similar effect when used as a pesticide. In soil and water management systems, the application of lime (i.e.,  $\text{CaCO}_3$ ) is recommended to neutralize the acidity generated via sulfur oxidation.... there are no known reports that suggest any specific chemical interactions between elemental sulfur and other substances used in organic crop or livestock production or handling. Elemental sulfur does react vigorously with chlorates, nitrates, and other oxidizing agents...To the best of our knowledge, there are no known reports that suggest any specific chemical interactions between elemental sulfur and other substances used in organic crop or livestock production or handling".

Sulfur as used in the proposed pellet formulation is unlikely to have detrimental chemical interactions with other materials used in organic farming systems.

2. 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)]

Information on the specific mode of action of sulfur on mollusks is not provided. Sulfur is a contact fungicide, and also kills mites. Sulfur may inhibit arachidonic acid metabolism and platelet plasma membrane function. Consumption by ruminants of a high dietary percentage of sulfur as elemental sulfur or sulfate can cause toxic effects. Sulfur bacteria may produce the poisonous gases hydrogen sulfide and sulfur dioxide that affect respiration.

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

As described in the Livestock Sulfur TR, elemental sulfur is transported from mining, manufacturing and transshipping sites in pipelines and in tank cars in molten form. Molten sulfur has the potential to emit hydrogen sulfide gas, which 1) presents a safety hazard to those working in the vicinity and 2) an environmental hazard, since  $\text{H}_2\text{S}$  is very toxic. Pollution of the soils can take place where elemental sulfur is stored in the open. Wind eroding fine dust from

stored in the open is deposited downwind of the manufacturing or storage facility. Over several years surrounding soils can become acidified with pH as low as 1.

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

Overall, sulfur is considered a low toxicity/low risk material (<http://extoxnet.orst.edu/pips/sulfur.htm>). It is a known respiratory and eye irritant and causes dermatitis. Direct exposures to farm workers can be mitigated if label recommendations and proper personal protective equipment recommendations are followed. New research suggests associations with agricultural field applications and poorer respiratory function in children living in agricultural communities (Raanan et al. 2017: <https://www.ncbi.nlm.nih.gov/pubmed/28886594>). However, the proposed use as a snail and slug bait in pellets will likely not result in eye, skin, or respiratory protections. Appropriate protection should be provided to workers handling sulfur products as needed (eye protection, gloves, respirator). Any adverse exposures incidents should be reported to local pesticide regulatory agencies and the NOSB.

5. 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)]

Sulfur is a naturally-occurring element and is ubiquitous in the environment. Too much sulfur (e.g., from a sulfur storage or manufacturing facility) will cause the pH of soil to drop very low. High sulfur contamination and subsequent acidification can negatively affect earthworms, snails, and some ground beetle.

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

The use as proposed is unlikely to adversely impact biodiversity.

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

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

As noted in prior petitions for ferric phosphate and repeated by the current petitioner, “slugs can be captured in traps and killed manually by the farmer. These traps can consist of: a) holes in the ground with a covering; b) boards; and c) various manufactured traps that use bait, e.g. beer, yeast. There are also biological controls for slugs. Various birds will eat slugs and snails. The problem with using animals as control methods is that they also tend to damage the crop. There are fly and beetle species that might provide control, however, the supply is not consistent. Predatory snails can destroy pest snails. However, these snails are not native and their use is restricted.” A predatory nematode is available in Europe and Britain but is not currently sold in the US ([http://ucanr.edu/sites/CalSnailsandSlugs/Management/Natural\\_enemies/](http://ucanr.edu/sites/CalSnailsandSlugs/Management/Natural_enemies/)).

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

**National List Motion:**

Motion to add sulfur, as petitioned, at §205.601(h) of the National List of Allowed and Prohibited Substances.

Motion by: Asa Bradman

Seconded by: Harriet Behar

Yes: 7 No: 0 Abstain: 0 Absent: 2 Recuse: 0